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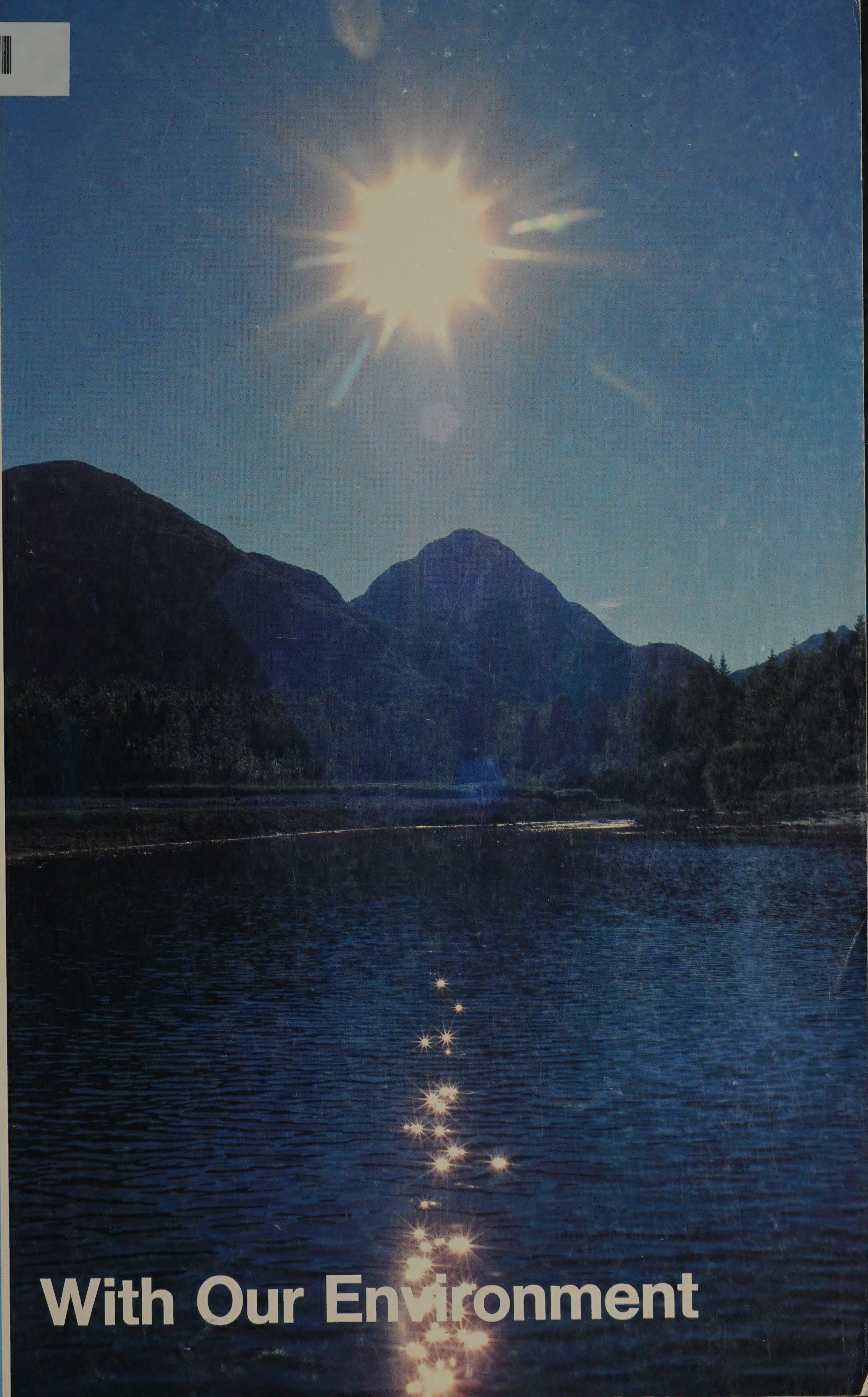

With Our Environment

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VIRGIN STANDS OF REDWOODS like this have been saved by expansion of Redwood National Park in northern California. In negotiation with the State is a plan whereby the National Park Service would assume management of the three redwood State parks within the boundaries of the national park. They are Jedediah Smith, Del Norte and Prairie Creek.

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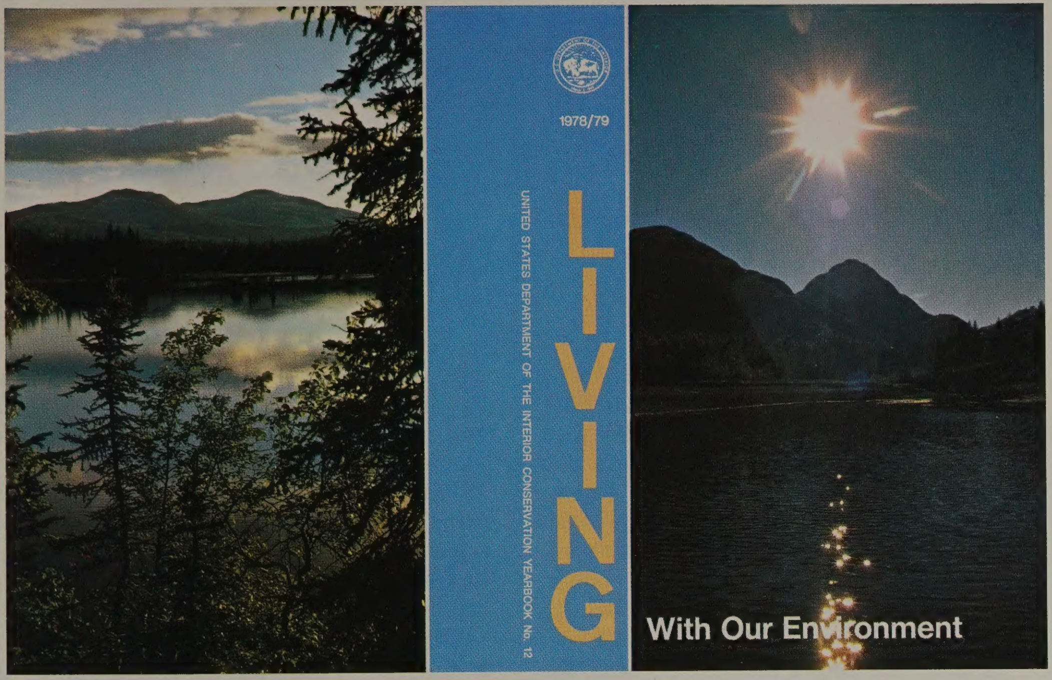
1978/79
LIVING
UNITED STATES DEPARTMENT OF THE INTERIOR CONSERVATION YEARBOOK No. 12
With Our Environment

ABOUT THE COVERS

AT THIS TIME of decision for our largest State, the editors felt that this Conservation Yearbook should be wrapped in something of an Alaskan essence. Thus we have chosen scenes that reflect the normal lights seen by those enraptured by the Alaska landscape.

It is not so much the overriding presence of a Mount McKinley that inspires both native and newcomer to claim Alaska as one's own, but the awesome canopy of summer light above a panorama of endless mountains and waters. For our front cover we show late afternoon light refraction after a storm at an inlet of Glacier Bay. Now compare this with our back cover, photographed at sunrise 650 miles west across the Gulf of Alaska.

Between these glories we invite the reader to savor the greatness of our natural resources and to ponder man's place in their natural beauty.

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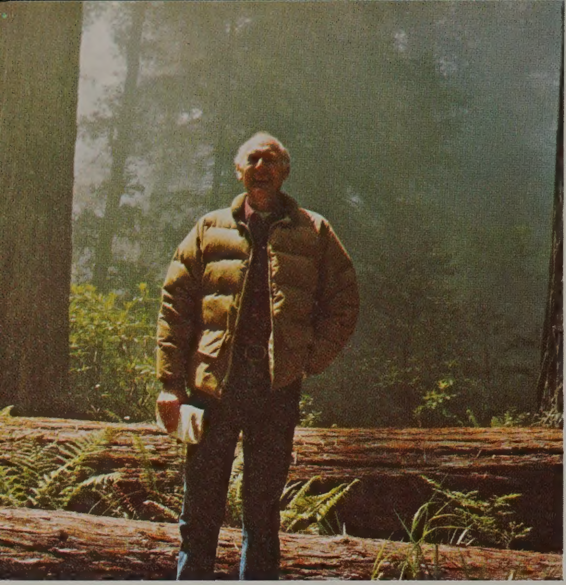


Secretary's Message

"Earth does not belong to man, Man belongs to the Earth."

This slogan expressed at Spokane's Expo '74 states a fact, not an opinion. Man is ultimately tied to his environment. If we treat it well, it will sustain us and enrich our lives. If not, we will perish from the earth.

In essence, our situation is no different than that of such endangered or threatened species as the bald eagle, whooping crane, key deer or American alligator. Loss of habitat, unrestricted pesticide usage or any number of manmade impacts could doom their survival. Our species' environment is the whole earth, but that, too, is limited.

Other life is also part of an organism's environment. In testimony before the Congress, it was put this way:

"Experience has confirmed that it is only through the ability to provide protection to the full spectrum of plant and animal life that we are able to afford protection to any particular species. If we are to preserve . . . the bald eagle, the peregrine falcon, . . . the grizzly bear, we must conserve the network of life upon which they depend."

As life is linked, so are environments. Establishment of Redwood National Park in California did not fully protect the giant trees within its boundaries. Erosion of soil from adjacent logging areas silted streams so that overflow threatened the stability of giant trees within the park. It took the addition of 48,000 acres of critical watersheds to preserve the redwoods' total environment.

In turn, our earlier failure to protect the Big Cypress Preserve, the watershed for Everglades National Park, has led to huge expenditures to maintain the water sustenance of this unique subtropical region.

Thinking of watersheds brings me to one of the most basic environmental topics—the use of water. As Westerners like myself are acutely aware, nothing is more vital to life than water. In the past we tended to think we could always get more. If it wasn't on the surface, pump it out of the ground. Now, as groundwater levels drop drastically in Arizona, western Kansas, and other areas, we realize with new force that water supplies are limited.

This means we must better measure our water resources and calculate future demands, establish priorities for water project construction or improvement, and better coordinate the many water programs that now exist. Since rivers and underground supplies respect no manmade boundaries, we will need close cooperation among State and national governments in water use planning.

Nonhuman life needs water, too, for drinking and for a home. When we tap lakes and streams, we must leave enough water to sustain trout and beaver, ducks and deer.

Our link with the earth is most evident in the food it provides us. Conservation of our croplands, which are being taken for other uses at a disturbing rate, should be a concern of every citizen. Grazing land, too, is a precious resource. As custodian of millions of acres of land used for grazing, the Interior Department is working hard to maintain or restore healthy vegetation on these areas. And not just for livestock. Wildlife, both game and nongame, also has a right to this food and cover. Under provisions of the Federal Land Policy and Management Act of 1976, 50 percent of funds from fees for grazing on public lands is being used for range improvement.

Getting food and water from the earth is a relatively gentle operation, but getting coal, oil, and gas to fuel industry sometimes tears the environmental fabric unmercifully. Surface mining for coal, for instance, can lead to erosion, stream sedimentation, loss of crop and timberland, disfigurement of

the land, and disruption of human lives. Interior's new Office of Surface Mining was created to help see that all our environmental skills are applied effectively in the control of stripmining and repair of stripmined areas.

Public lands in the West contain large coal deposits. In the leasing process, the Interior Department will watch closely to see that we mine lands where the production is needed most, where the environmental consequences are the least, and where reclamation can be successfully achieved.

In response to our Nation's need for accelerated oil and gas deliveries from domestic sources, we have embarked upon a well-ordered series of Outer Continental Shelf lease sales not only in the Gulf of Mexico but also in the Atlantic, Pacific, and coastline waters of Alaska. Strong environmental safeguards are always uppermost in our plans as we seek to lessen our dependence upon imported energy supplies.

The possibility of accidents in offshore oil and gas production can be a threat to marine life and to the welfare of shoreline communities. To minimize these risks, we have strengthened the requirements for study of environmental aspects of drilling on the Outer Continental Shelf and have broadened the role of local governments and citizens in discussions of proposed oil and gas leasing.

All this watchdogging is necessary, of course, because we will always need a healthy land and sea to support us.

Looking northward, we see the continent's most beautiful testing ground for our environmental wisdom. Rich in resources, both material and scenic, and lightly touched by human hands, Alaska offers us a chance to apply what we have learned so painfully in the Lower 48 about living with our environment. In our Nation's growth, we learned that deserts and grasslands call for different handling than eastern forests. Now in Alaska we must understand and respect far northern environments and the life they sustain. It is a rough but fragile land.

Back in 1872, with the formation of Yellowstone National Park, the Congress set in motion what has since become a worldwide endeavor, that of conserving outstanding natural areas for the benefit of all people.

Now, in what many consider the most crucial environmental decision of *this* century, the Congress during 1978 was being asked to decide on the extent of national interest lands to be conserved in Alaska.

There the President of the United States and the Department of the Interior seek to conserve whole ecosystems in the "four systems" of national parks, wildlife refuges, wild and scenic rivers, and forests—under provisions of the Alaska Native Claims Settlement Act.

Every day environmental decisions become tougher. The growing demand for space and material goods is running head on into environmental constraints. A distinguished former Under Secretary of the Interior, the late Dr. William Pecora, expressed this challenge well in a lecture at the University of California in 1972:

"A mature Nation like the United States, so dependent upon its natural resources, cannot turn off its economic pattern of development without a major impact upon its welfare and way of life. Nor can this Nation continue its economic development without more regard for the environmental impact of its industry. The public interest is a multifaceted structure requiring the full attention and prudence of government."

Somewhere along the line, and soon, we will have to reshape the current American Dream of ever increasing wealth. We have come a long way toward a chicken in every pot and a car in every garage. Perhaps it's time now to strive more for spiritual riches—riches that come from harmony with our fellow man and with our environment. Early American Indians, though they had no more success in living peacefully than current earth dwellers, did respect and reverence the land. We would do well to develop the attitude expressed by Chief Joseph of the Nez Perce tribe:

"Do not misunderstand me, but understand me fully with reference to my affection for the land. I never said the land was mine to do with as I chose. The one who has the right to dispose of it is the one who had created it . . ."

Achieving such harmony will take not only dedication to a philosophy but also a lot of hard work. This Conservation Yearbook shows some steps—from habitat protection of endangered species to international cooperation in environmental research—which the Department of the Interior is taking to conserve our environment while its resources are being used.

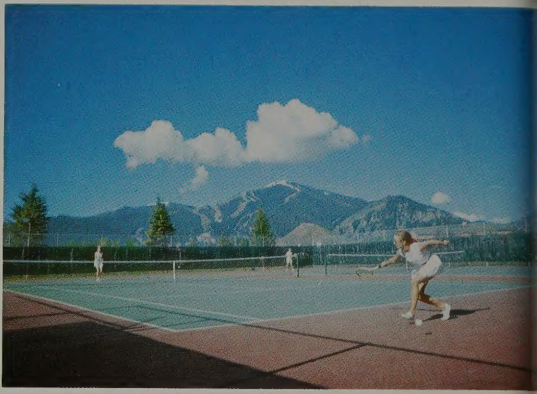
We also celebrate here the joys of our beautiful earth. As far as we know, there's nothing like it in the universe.

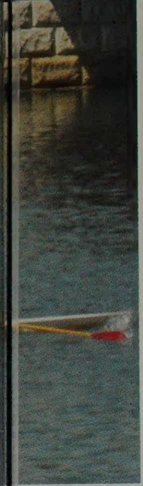
Cecil D. Andrus

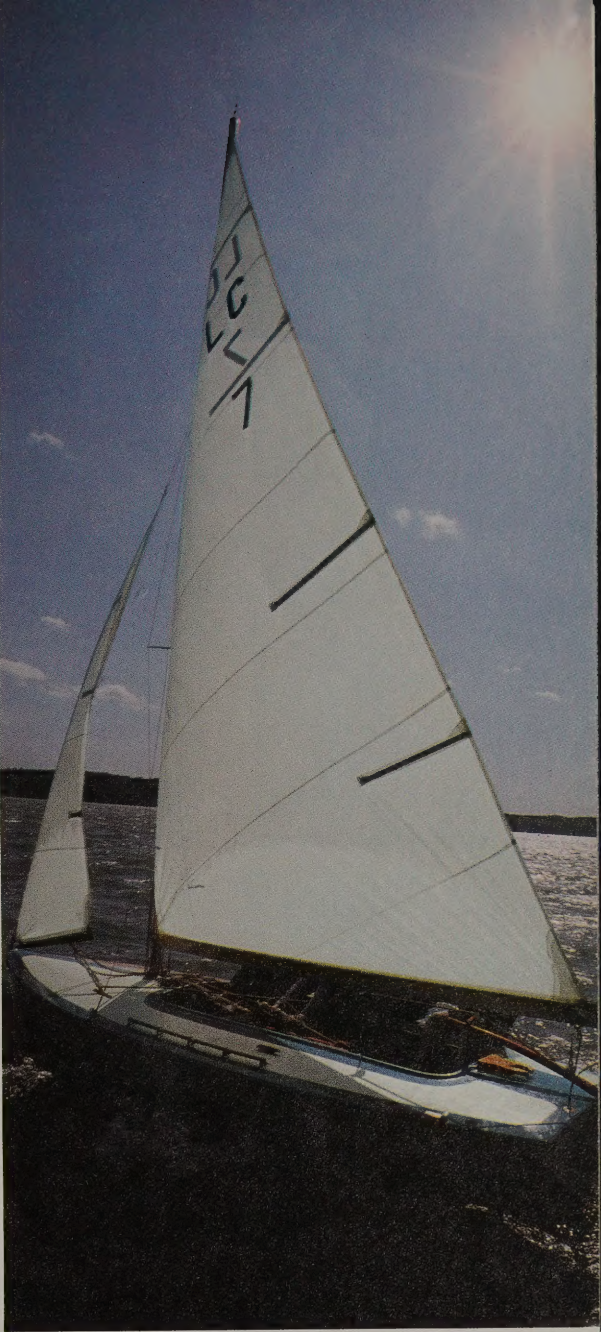
ENJOYING
OUR ENVIRONMENT

Chapter I

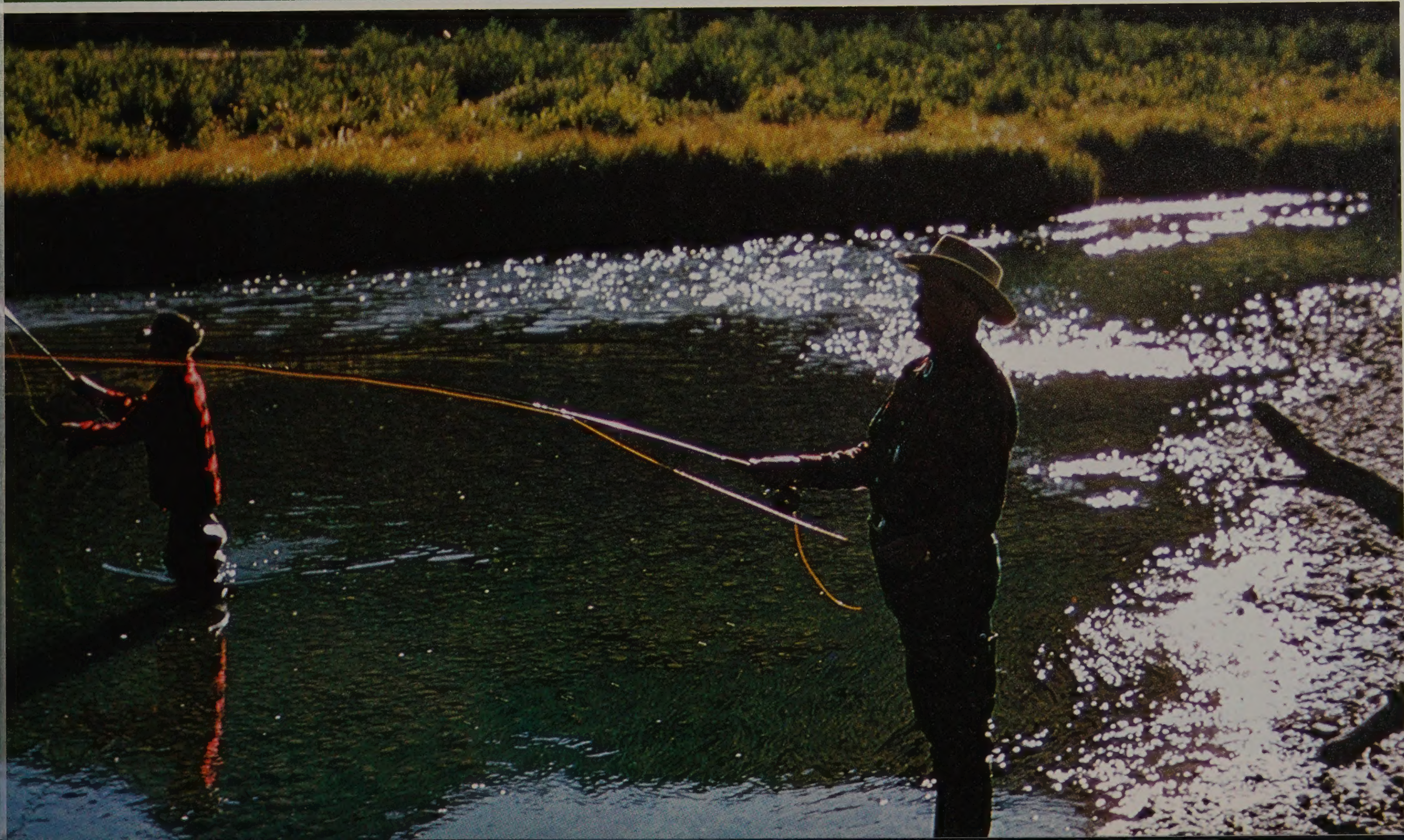
ALASKA is not all polar bears and ice caps. This pleasure craft is sailing along the flower lined banks of Bartlett Cove in Glacier Bay National Monument.





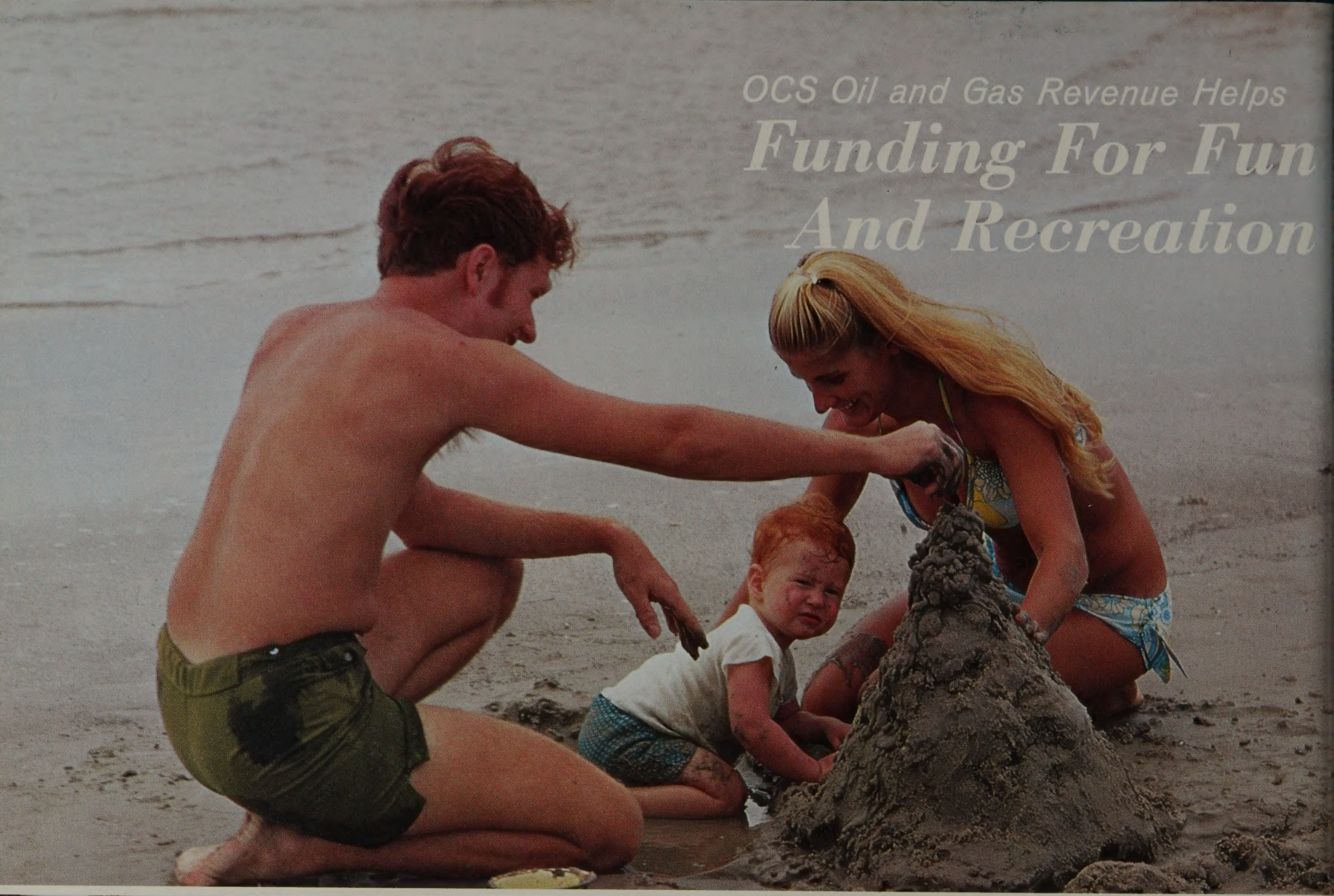


America at Play



OCS Oil and Gas Revenue Helps

Funding For Fun And Recreation



By Leo Willette

Slivers of sun sparkle through leaden skies. The wet spring of '78 prepares to loosen its soggy grip over Southern California.

Will this—finally—be *the* weekend for the Bike Path?

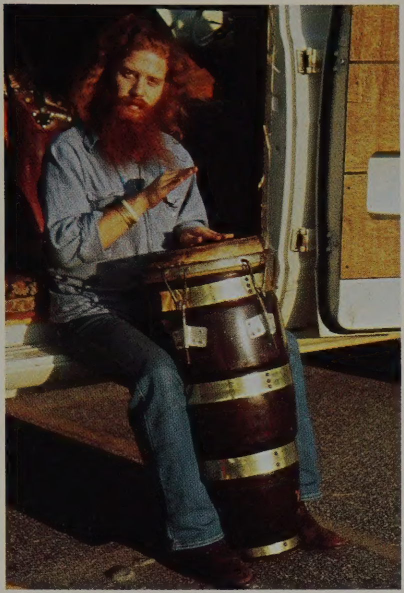
Ready or not, here they come:

> Youngsters and not-so youngsters, fishing poles perched on bike handlebars, heading for nearby piers . . . Surf-waders, sloshing ankle-deep in foam . . . A bongo player, setting up shop for the day . . . Kids shaping sand castles, in a no-win cause against time and tide . . . On the bike path, slender roller skaters poise, watching for the boys.

In bare feet and Adidas they come; in costumes ranging from color-coordinated to what might charitably be called "rumpled casual." California's South Bay Bike Path in Los Angeles County starts to throb with people.

This bike path fairly shimmers along its 19.1-mile strand. Serpentining along the Southern California coastline from Santa Monica to Redondo Beach, it strings together a wide array of outdoor offerings.

In its settings of urban recreation and renewal, the bike trail is not merely a route to get from one place to another. It's much more. It's an introducer—a neighbor-maker.



One hears it in the sounds:

"Can I borrow your bike pump a second?"

"Neat camera. What kinda film ya using?"

"Anything biting off the pier?"

"Hey, mom . . . I caught me a clam."

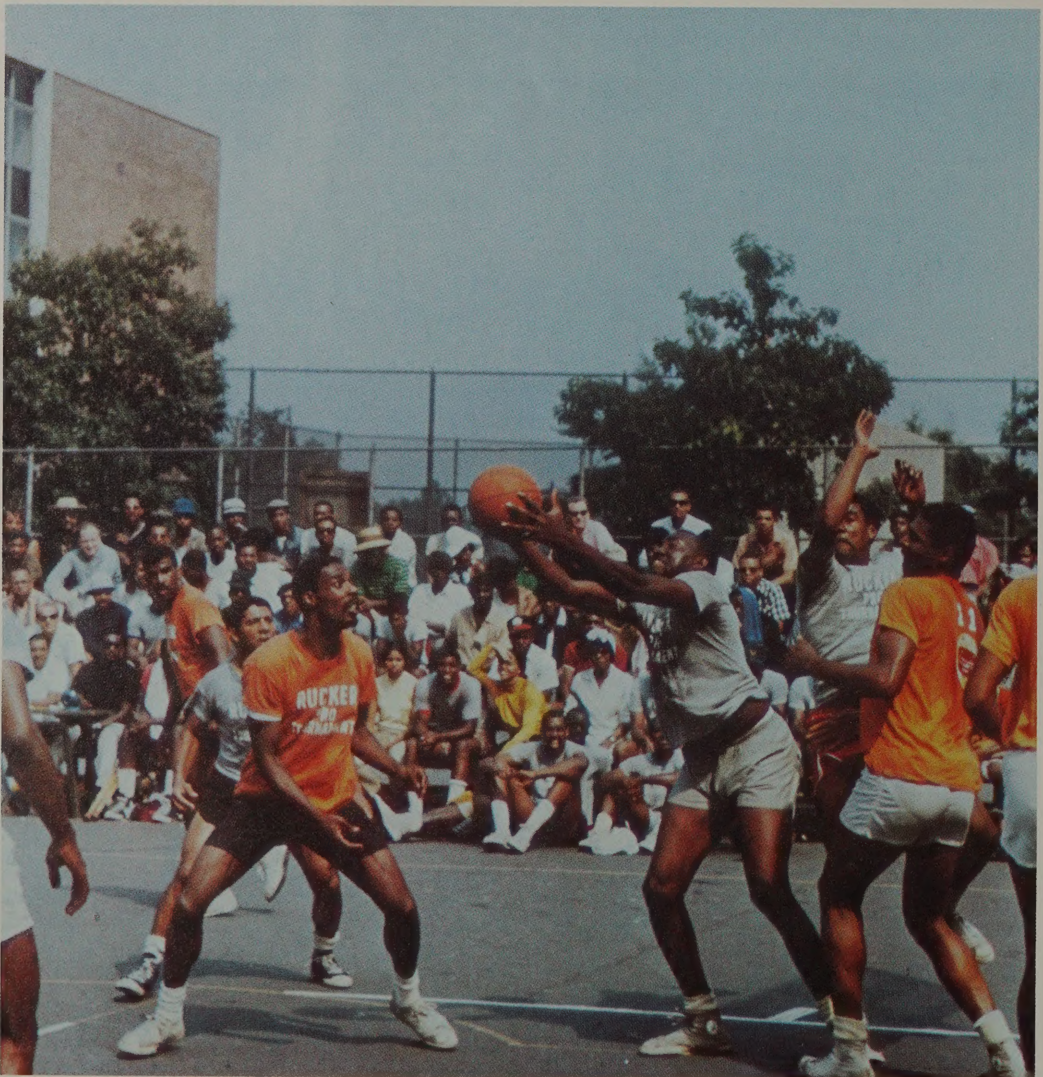
Although more photogenic than some of its cousins across the country, this recreation resource shares direct kinship with:

A small patch of green space in Newark . . . Public beaches in (of all places) Hawaii and Puerto Rico . . . A trail along a meandering river in Ohio . . . Family picnicking sites beside a southwestern mountain range . . . Public oyster beds off the coast of South Carolina.

The common link is the Land and Water Conservation Fund. The Land and Water Conservation Fund Act of 1965 (Public Law 88-578) established the fund to provide for:

- Acquisition of lands for federally managed parks, forests, wildlife refuges, and recreation areas (the Federal aspect of the program); and
- Matching grants-in-aid for acquisition and development to States, and through the States, to cities, counties, towns, etc. (the State side of the fund).

From the first grant in 1965 through Fiscal Year 1977, the fund has assisted 19,318 recreation projects throughout America. Historically, the States have received at least 60 percent of the millions of dollars appropriated annually to the fund. Because of this, the fund has been the Federal Government's most wide-ranging program in support of public recreation.



Fund Administration

On January 25, 1978, the Secretary of the Interior announced creation of a new agency, the Heritage Conservation and Recreation Service (HCRS). The HCRS brings together most of the functions of the former Bureau of Outdoor Recreation and the programs of the National Park Service's Office of Archeology and Historic Preservation and the National Natural Landmarks Program. One of the major functions of the new agency is the administration of the Land and Water Conservation Fund.

Chris Therral Delaporte, the first director of the Heritage Conservation and Recreation Service, is aware of the fund's importance to central cities, especially hard-core urban areas.

"If the texture of American life is to be enhanced, quality-of-life improvements must include recognition of the roles of recreation, a sense of 'neighborhood,' a feel for where Americans have been, and a sense of purpose as to where we're heading," he says.

To focus on where the fund is heading, one must first consider where it has been:

> What has it accomplished so far?
>
> How do the "priorities" of the fund complement the challenges of the cities?
>
> Is the program top-heavy in support of suburbs and rural areas at the expense of urban needs?

The First 13 Years

At the end of Fiscal Year 1977—a period covering the first 13 years of the Land and Water Conservation Fund—assistance to the States totalled more than $1.539 billion. The State side of the program also covers grants to the District of Columbia, American Samoa, Guam, Puerto Rico and the Virgin Islands.

Since the matching grants provisions of the fund attract at least an equal amount of support from sponsoring States, counties, and communities, the full impact of fund investments is doubled—to $3.078 billion or more.

Types of assistance to the States in millions of dollars:

PLANNING	**$17.62**
ACQUISITION **(266,972 acres)**	**$640.76**
DEVELOPMENT	**$880.71**

Metropolitan vs Rural

Where are these grant projects located? In Metropolitan areas or in more rural regions?

Although no single year is ever "typical" of fund support, data for FY 1977 provides a profile. Project locations can be categorized as those in *Standard Metropolitan Statistical Areas* (SMSAs) and those in non-SMSAs.

The following table reflects the metropolitan/non-metropolitan breakdown of assistance for FY 1977:

	Number of Projects	L&WCF in Million $	Acreage
SMSAs	**1,074**	**$118.5**	**54,695**
Non-SMSAs	**1,423**	**$ 73.3**	**212,277**
FY Total	**2,497**	**$191.8**	**266,972**

Clearly, more dollars went into metropolitan areas—61 percent of the obligated funds.

Yet a greater number of projects, involving a greater number of acres acquired, were directed to non-metropolitan areas. This is understandable, since acreage and development costs are generally higher in urban locales.

Top 10 Projects Funded

Recreation fads come and go, yet old favorites continue to provide lasting recreation rewards. Such enduring qualities are reflected in the types of recreation projects supported by the State aspect of the funding program from 1965 through 1977.

Type of Activity	Projects Supporting the Activity
Picnic Facilities	**1,756**
Family Camping Facilities	**1,362**
Trails (various types incl. hike/bike/horse)	**1,156**
Boat Launch	**796**
Fishing Access	**788**
Natural Areas	**703**
Beach Areas	**582**
Playgrounds	**557**
Public Golf Courses	**365**
Tennis Courts	**346**

Although the enduring qualities of the types of recreation projects listed cannot be denied, aside from the category of playgrounds, they rarely affect the daily lives of most urban dwellers. Family camping seldom becomes a reality to inner-city families.

Their world would be better enhanced by a neighborhood community center within walking distance from their homes. Such an urban retreat could provide recreation activities and classes in crafts or sports for people of all ages—facilities sadly lacking in many cities.

The need for providing urban dwellers with recreational activities is well summarized by Under Secretary of the Interior James A. Joseph:

> "A week in the mountains may be a wonderful and revitalizing escape from the numbing routines of urban life. But its brief exhilaration cannot carry one through 51 weeks of life trapped in the inner-city constrictions of brick and asphalt, mind-numbing routine, and depressing lack of recreational opportunity. Many of those who need recreation opportunities the most are the least able to attain them."

Only by a stretch of the imagination do the shadows from offshore oil rigs reach bike paths, beaches, playgrounds and pools across the national scene.

But in both real and symbolic ways, these spindly structures do touch the lives of all who use the South Bay Bike Path, as well as the millions who seek recreation and renewal at the more than 19,000 other places enhanced by the Land and Water Conservation Fund.

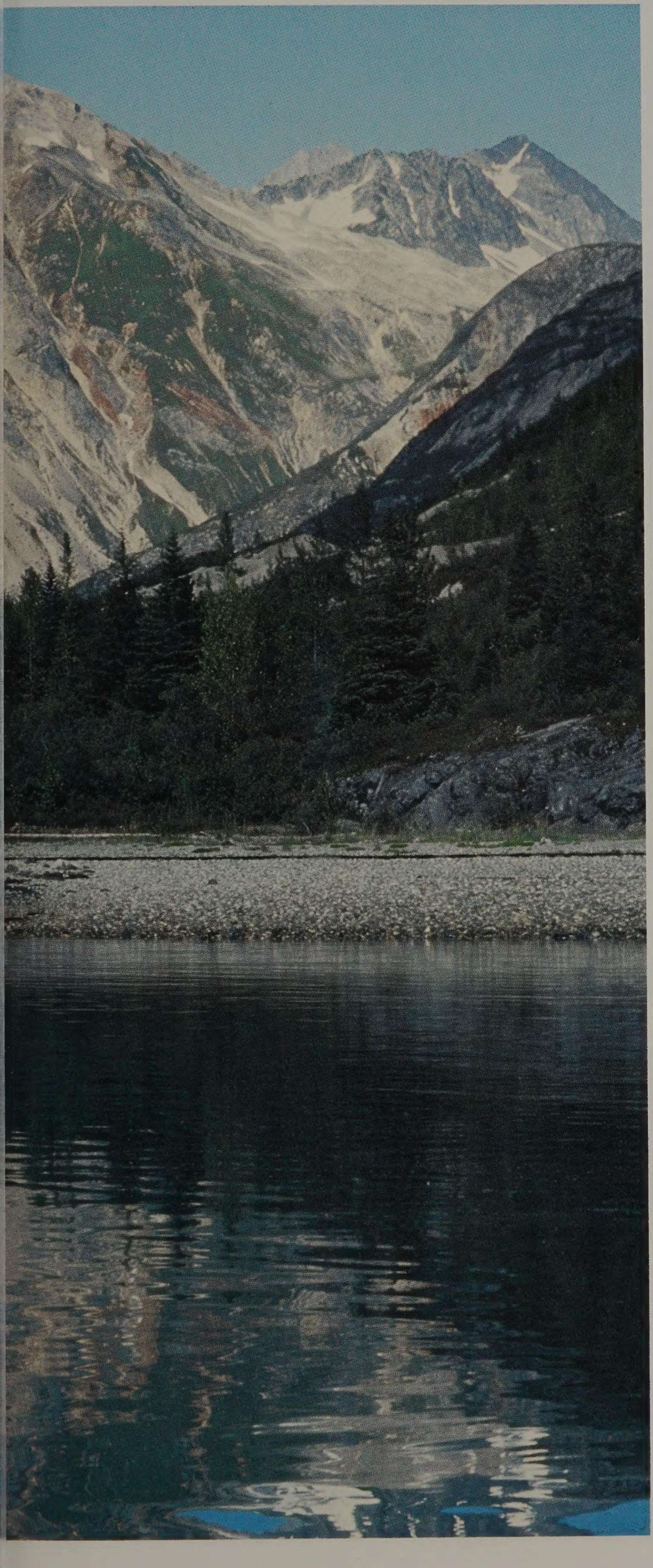
For the major share of the fund is derived from revenue produced by Outer Continental Shelf oil and gas leasing.

At a time when the Nation's energy resources and human resources must be weighed and balanced, it is worthy to consider that bounties from a nonrenewable resource—our offshore energy—are being passed on to a most renewable resource—the American people.

ALASKA-

OUR LAST CHANCE

Glacier Bay, at Black Cap Mountain



By Cecil D. Andrus

Secretary of the Interior

ALASKA IS WHERE space and time, imagination and reality, all come together.

Here are seemingly limitless horizons of snow-capped peaks, punctuated by valleys with both clear and glacial streams. The immensity of Alaska embraces sand dunes and ice fields, rain forests and frozen tundra. I've made four trips there and each time it simply overwhelms me.

Alaska is where great herds of caribou roam over thousands of square miles in a domain populated by Dall sheep, grizzly bears and wolves. Here are nesting grounds for countless migratory wildfowl whose flights to the "Lower 48" are like seasonal clockwork. Its coastal waters, fjords and broad river estuaries are home for salmon and whales, seals and otters. It is a place where a single glacier is as large as our smallest State, where an alluvial valley produces berries and grains—plus cabbages of variegated colors, so huge that they are used as hotel lobby decorations.

Here live the walrus and the ice-roving polar bear. Very much alive here, also, is an ongoing controversy over how much of these "crown jewels" of wildlife and scenic beauty should be conserved in parks, wilderness areas, wildlife refuges and wild and scenic river systems. All of these are official designations of protection much sought by conservationists while protested as a "lock up" by equally sincere advocates of commercial and trade expansion for our 49th State.

In the spring of 1978 the United States House of Representatives voted overwhelmingly, 277-31, to set aside some 102 million acres of Alaska lands and waters for national parks, wildlife refuges, wild and scenic rivers, and forests. Of this area (about equal in size to the State of California) some 66 million acres were included as wilderness, a classification which under law excludes development, but in Alaska, very importantly, will still permit traditional uses of access, such as by airplane and snowmobiles.

While the House-passed measure leaves 61 percent of the potential hard rock mineral areas outside the boundaries of protection and authorizes some oil and gas leasing in certain parts of the protected lands, opponents charge that the wilderness classification would prevent the development of potentially profitable mineral resources within the vast State. The criticism comes despite the fact that I very carefully drew many of the proposed boundaries so as to exclude most major mineral areas.

The controversy sprang from provisions of the Alaska Native Claims Settlement Act of 1971 which provided for the selection of more than 44 million acres by the Eskimos, Aleuts and Indians through their Native Village and Regional Corporations, and payments of nearly $1 billion. Many of these 44 million acres and the 103 million acres selected by the State of Alaska under its Statehood Act will be open to development, or protection of hunting grounds, as the new owners choose. In addition, tens of millions of acres in Federal ownership will be managed on "multiple use" principles by the Bureau of Land Management and the Forest Service.

President Carter's proposal, as presented by me to Congress in the fall of 1977 was for protection of 92 million of Alaska's 375 million acres—about one-fourth of the State's land and water area.

Recommendations were made under Section 17(d)(2) of the Alaska Native Claims Settlement Act, hence frequent reference to "d-2 lands." As I testified, these d-2 lands would add approximately 45.1 million acres to the National Wildlife Refuge System

Mountain goat

and 41.7 million acres to the National Park System, more than doubling the total size of each system nationally. The Administration also recommended 33 rivers and river segments for inclusion in the National Wild and Scenic Rivers System (about 2.45 million acres) plus additions of 2.5 million acres to existing National Forests.

The Four Systems management plan so proposed would establish 10 new units of the National Park System while expanding three existing parks. The U.S. Fish and Wildlife Service would acquire nine new refuges and expand five others.

Most importantly, the Administration proposal attempted to conserve entire natural ecosystems and watersheds so as to avoid repetition of costly mistakes made for more than a century in setting aside lands and waters for preservation in the Lower 48. As example, American taxpayers have had to pay premium prices to purchase additional redwoods acreage to protect Redwood National Park. All of this land was once part of our public lands as is most of Alaska today. I call these "environmental salvage" operations, and say that in Alaska "we have a last chance to do it right the first time."

While space in this Conservation Yearbook does not allow details of all the park and wildlife areas sought for conservation under National Interest Lands legislation, this passage from the original proposal is illustrative:

"As the Yukon joins the Kuskokwim River there is created one of the wettest spots in this Nation. The Yukon Delta National Wildlife Refuge (10.5 million acres) is a vast, water dotted tundra. Probably no area of similar size is so critical to so many species.

"Fish and Wildlife resources include at least 100 million shorebirds of several species; 3 million ducks, 50,000 swans (80 percent of the Pacific Flyway flight) and 720,000 geese (including 80 percent of the world's emperor geese, all of its cackling Canada geese, and half the continental population of black brant); and a large fishery resource (chinook, chum, coho, sockeye and pink salmon, northern pike, blackfish, sheefish and several species of whitefish, grayling and Arctic char) which is the subsistence mainstay of 42 Native Villages encompassed by the refuge.

"Add to this a mammal resource including foxes, otters, mink, hares, lemmings, bears, lynx, wolves, beaver, wolverine, moose, harbor seals and walrus; another 100 nesting bird species scatter-

Curious porcupine

Mt. St. Elias, Icy Bay

Yellowlegs

Polar bear

Chulitna Bay, Lake Clark

Native children at home

Anchorage, photographed in August at 11 p.m.

Northern Eskimos fishing through the ice

A moose crosses under the pipeline.

ing to six continents, and the Yukon Delta becomes a remarkable wildlife wildland."

Historically Americans have looked to the present as their guide. The past is full of examples of our lack of regard for the future. Half a century ago engineers were seeking to drain "the worthless river of grass" that we now cherish as Big Cypress National Preserve and Everglades National Park. In the 19th century the fashion rage for beaver felt hats nearly wrought the extinction of that animal in much of the west.

It was not surprising that Americans laughed at Secretary of State William H. Seward's purchase of Alaska from Russia in 1867 for 7.2 million. The place was cold, faraway and seemed useless. It was called "Seward's Folly" and "Seward's Icebox" by a generation of comedians.

Today, though, we have begun to look to the future as well as the past and present. The remoteness which made Alaska into Seward's Folly 100 years ago protected it from much of the unthinking and unplanned development of America's early years. In a Nation where the buffalo still roams only on ranches and in a few parks, we can still look to Alaska for huge herds of caribou and millions of nesting birds. Only in Alaska of all our country do the wilds of the past meet the conservation values of the future. Alaska still offers the chance to see America as it once was.

Congress recognized that the essence of Alaska's future had to be a balance between development and conservation when it passed the Alaska Native Claims Settlement Act, directing the Secretary of the Interior to study Alaska and nominate new conservation areas.

In the past conservation was usually a "salvage effort" carried out to protect some remnants of countryside or the last survivors of a once numerous species after we had made great changes in the land. Today we have embarked on an adventure in making conservation and development in Alaska two parts of the same process. We are starting to conserve in Alaska at a time when most land needs little in the way of management to maintain its natural productivity. And we are starting to develop Alaska in a way that should protect much of the State's wild allure for coming generations while producing important natural resources for the Nation.

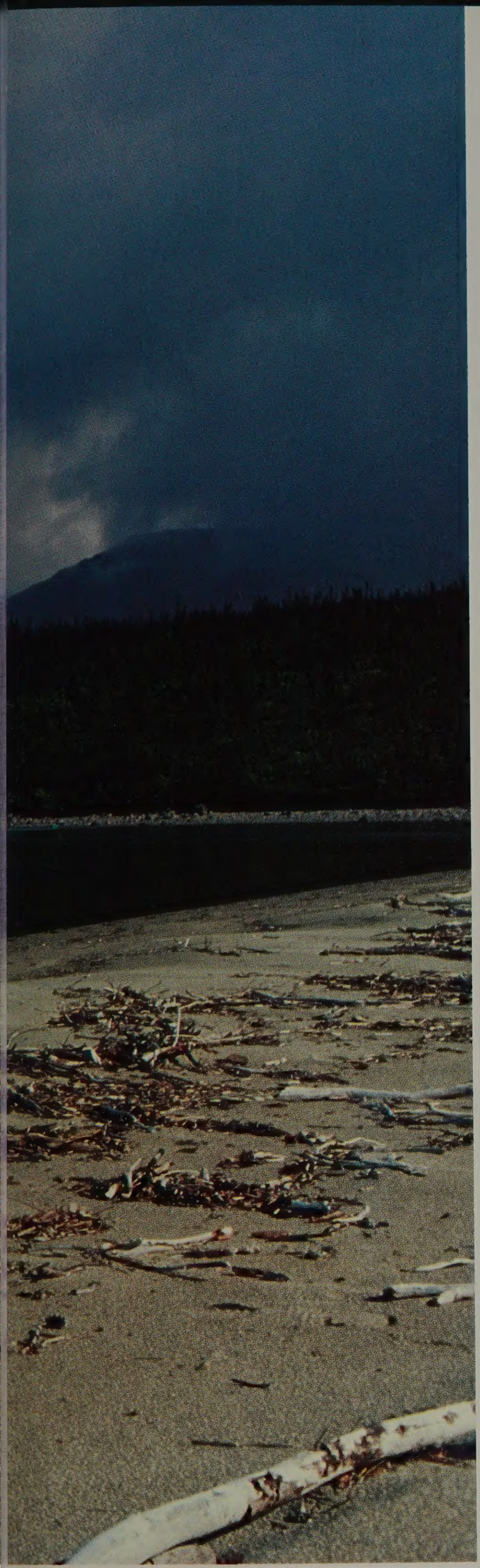
Hopefully, in Alaska we will not fumble away our "last chance to do it right the first time."

THE AGE OF ALASKA

By Robert Belous

ALASKA'S ENTRY to the American scene was deceptively modest. In March of 1867, Secretary of State William H. Seward persuaded a skeptical Congress to pay $7.2 million for an arctic thumb of our continent known as Russian America. The critics howled. Such epithets as "Icebergia" and "Walrussia" quickly became current coin. Characterizing the newly named Territory of Alaska, the New York *World* declared "Russia has sold us a sucked orange." The region was "utterly worthless," in the words of Missouri's Representative Benjamin F. Loan. Shrouded by myth and distance, Alaska's unique qualities would not emerge until long after cries of "Seward's Folly" had faded away. The boom and bust of a great gold rush would also come and go. Even a World War was destined to touch American soil in Alaska and pass into history before we would discover its remarkable and varied treasures.

Sheer breadth of landmass still hinders any simple grasp of its character, and lends to wild surmise. Some say Alaska defies measurement. Arrayed around Mt. Mc-



Beachcombers at Lake Clark

Brady Glacier, Glacier Bay region

Sarah Hornberger, a young "Old Settler," tends her garden at Turner Bay, Lake Clark region.

Kinley, North America's highest peak, is a sprawling subcontinent of 375 million acres—a fifth as large as the coterminous 48 states. While lush rain forests adorn its southern panhandle, its northern coast meets the Arctic Ocean and lies within a polar desert. East to west, the state spans four time zones. One bay is larger than Pennsylvania; one glacier is five times the length of Manhattan Island. Superimposed on a map of the U.S., Alaska stretches from North Carolina to Wyoming, and its islands to southern California. In fact, had cartographers not sought agreement to bend the International Dateline, part of Alaska would lie in tomorrow, spanning two days of the calendar. It is the largest peninsula on earth—larger than Spain and Italy combined.

A sign in a Fairbanks saloon seems to put it best: "If you explore a thousand acres each day, it would take over a thousand years to see all of Alaska. So take your time."

Some of the state's riches began to accrue while its landmass was deep under ancient seas. During Triassic times, more than 230 million years ago, large accumulations of porous sandstone began to form along what is now the north slope of the Brooks Range. Slowly combining with deposits of marine organisms, this rich brew simmered under heat from the earth's core. Ninety million years later, the formation was covered by a layer of organic shale which acted—and still acts—as a roof or lid. The Atlantic-Richfield Company drilled through that layer of shale at Prudhoe Bay in January of 1968 and discovered upwards of ten billion barrels of oil. In keeping with Alaskan superlatives, it proved to be the largest oil field ever found within the United States. The boom is still making headlines.

The process of mountain building and volcanism that gives Alaska its impressive skyline also created a metallogenic process which spawned substantial deposits of copper, lead, zinc, gold, silver and molybdenum. While dwarf horses and camels and saber-toothed tigers roamed the Early Cenozoic landscape, some 63 million years ago, decaying swamps began to form the future coal fields at Beluga, Matanuska,

Takahula Lake, Brooks Range (Gates of the Arctic)

Horned puffin, Matushka Island

Bald eagle at nest, Aialik Bay (Kenai Fjords)

and Bering River. Portions of the arctic slope are likewise underlain with coal deposits.

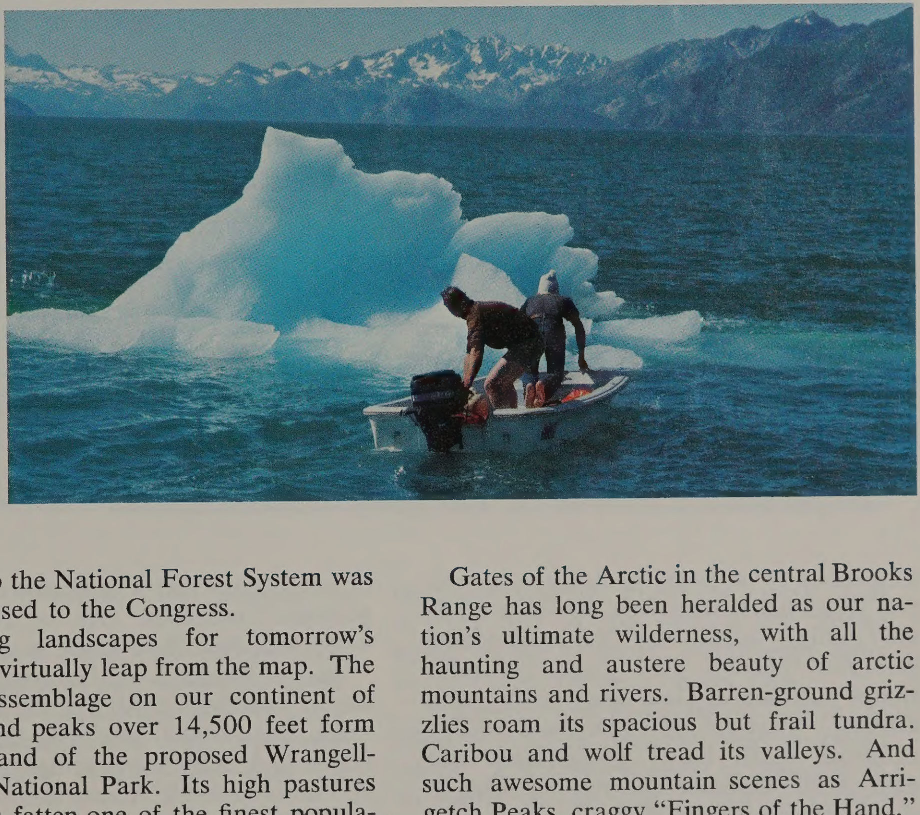
Add to its oil, coal and minerals, today's bounty of tall spruce and hemlock forests along the Pacific rim, and further add the world's leading salmon fishery, and Alaska emerges well endowed in an era marked by spiraling demand and diminishing supply.

With transition to statehood in 1959, the State of Alaska was awarded 103 million acres of Federal lands, including "all resources thereon and thereunder." The rich oil field at Prudhoe Bay was but one of the selections. Three miles of promising Outer Continental Shelf also came as part of the bargain. Considering the state's population of 380,000 (less than Seattle), assurance of a sound economic future is without precedent.

Further commitment of Alaska's resources has been charted by the Alaska Native Claims Settlement Act (ANCSA) of 1971. Aleut, Indian and Eskimo people will receive from the Federal domain over 44 million acres of ancestral lands, as well as payment of $962.5 million. Similar to the State's entitlement, this settlement of Native claims is the most generous in our history. Alaska's Native people have become the State's biggest private landholder.

And so we now turn to the question of just how to allocate the remaining Federal lands. Beyond its storehouse of raw materials, Alaska is blessed with awesome and unmatched works of nature not yet altered by the works of man. As a respite from the frenetic pace of modern society, there is the rare balm of unpeopled miles, tumbling rivers fresh as creation, wildlife and primeval wilderness without equal in our Nation. In section 17(d)(2) of ANCSA, the Congress addressed the national interest of all Americans in Alaska's natural, recreational and historic wonders. Final apportionment of publically owned lands must account for future National Parks, Wildlife Refuges, National Forests, and Wild and Scenic Rivers. Underscoring the importance of this historic opportunity, President Carter stated in his Environmental Message of May 23, 1977, "No conservation action the 95th Congress could take would have more lasting value

Tourism is big business in Alaska. Here visitors from the Lower 48 view Riggs Glacier at Muir Inlet.



Free ice, anyone? Local sailors fill their ice chest from a floating iceberg in Glacier Bay.

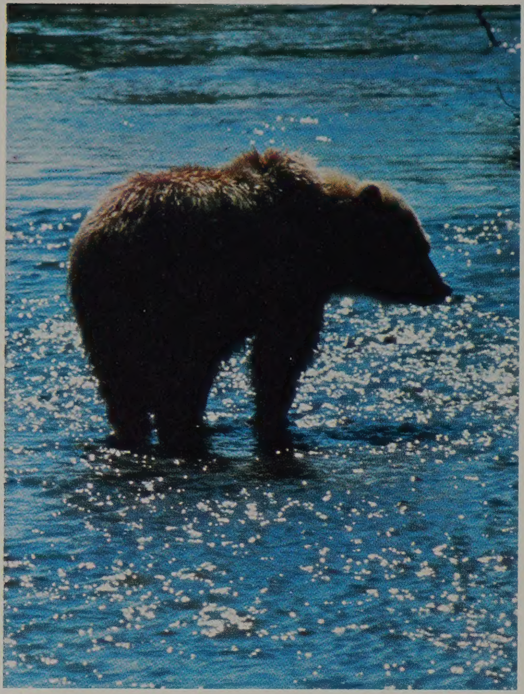
than this."

Deriving from six years of intensive field research, analysis and refinement, a final plan has emerged. On September 15, 1977, Secretary of the Interior Cecil D. Andrus recommended to the Congress that 92 million acres of land be set aside into the "Four Systems" management units. This included establishing 10 new units and expanding three existing units of the National Park System, comprising 41.7 million acres. Nine new units were proposed for the National Wildlife Refuge System, as well as expanding five existing units, for a total of 45.1 million acres. Thirty-three rivers were also recommended for inclusion in the Wild and Scenic River System, totalling 2.45 million acres. A 2.5 million acre addition to the National Forest System was also proposed to the Congress.

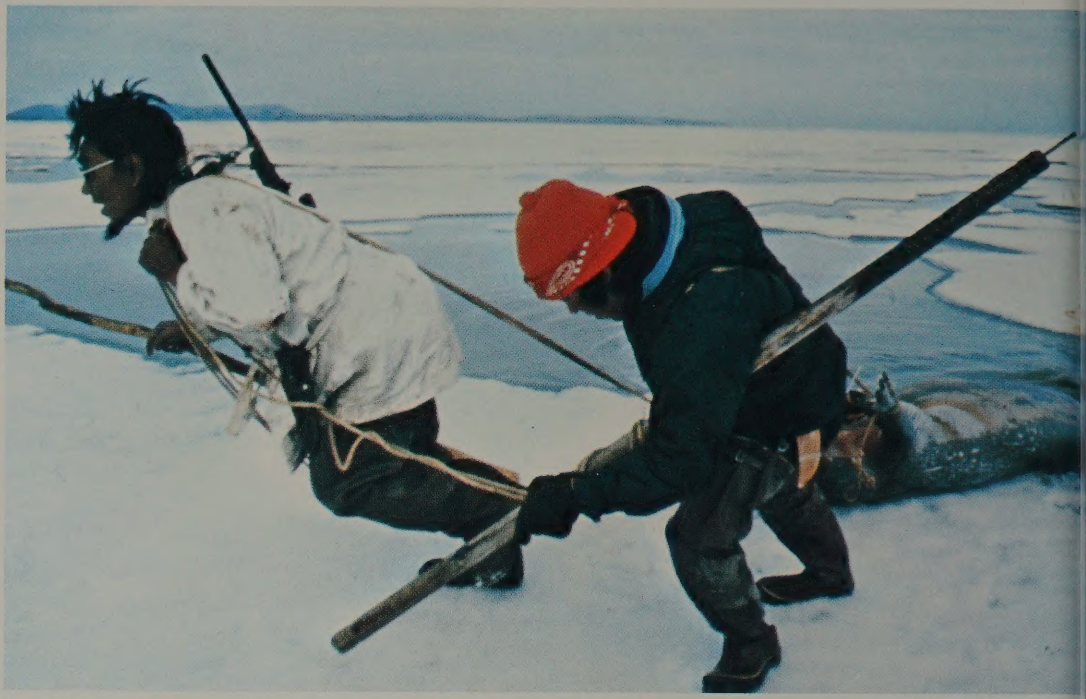
Inspiring landscapes for tomorrow's parklands virtually leap from the map. The greatest assemblage on our continent of glaciers and peaks over 14,500 feet form the heartland of the proposed Wrangell-St. Elias National Park. Its high pastures and slopes fatten one of the finest populations of cloud-white Dall sheep. Rivers and waterfalls lace its spacious valleys, where human endurance is the only limitation to new and startling vistas. "This," said a widely traveled Alaska Senator, the late Ernest Gruening, "is the finest scenery I have ever been privileged to see." The scene can even be viewed from the highway.

Gates of the Arctic in the central Brooks Range has long been heralded as our nation's ultimate wilderness, with all the haunting and austere beauty of arctic mountains and rivers. Barren-ground grizzlies roam its spacious but frail tundra. Caribou and wolf tread its valleys. And such awesome mountain scenes as Arrigetch Peaks, craggy "Fingers of the Hand," recall early Eskimo legend. The total acreage of Gates of the Arctic and Wrangell-St. Elias combined comprises approximately half of the 41.7 million acres proposed for new national parks.

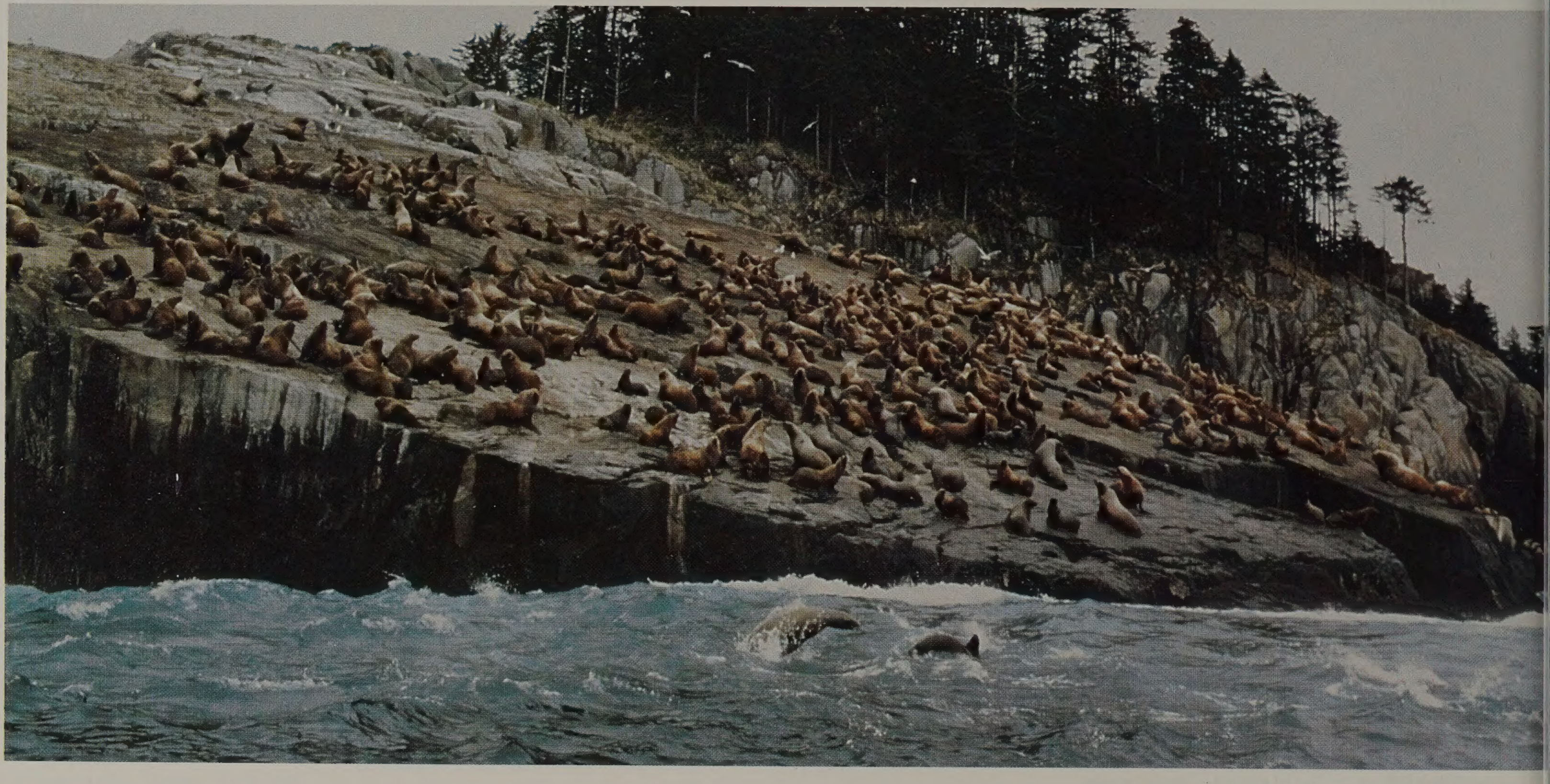
The Yukon-Charley National Rivers bring together history and prehistory. The wilderness environs of the Charley River sweep through some of the oldest geological



Brown bear, Katmai



Subsistence hunting yields Oogruk, the bearded seal, to Eskimo hunters at Cape Krusenstern.



Sea lions, Chiswell Islands

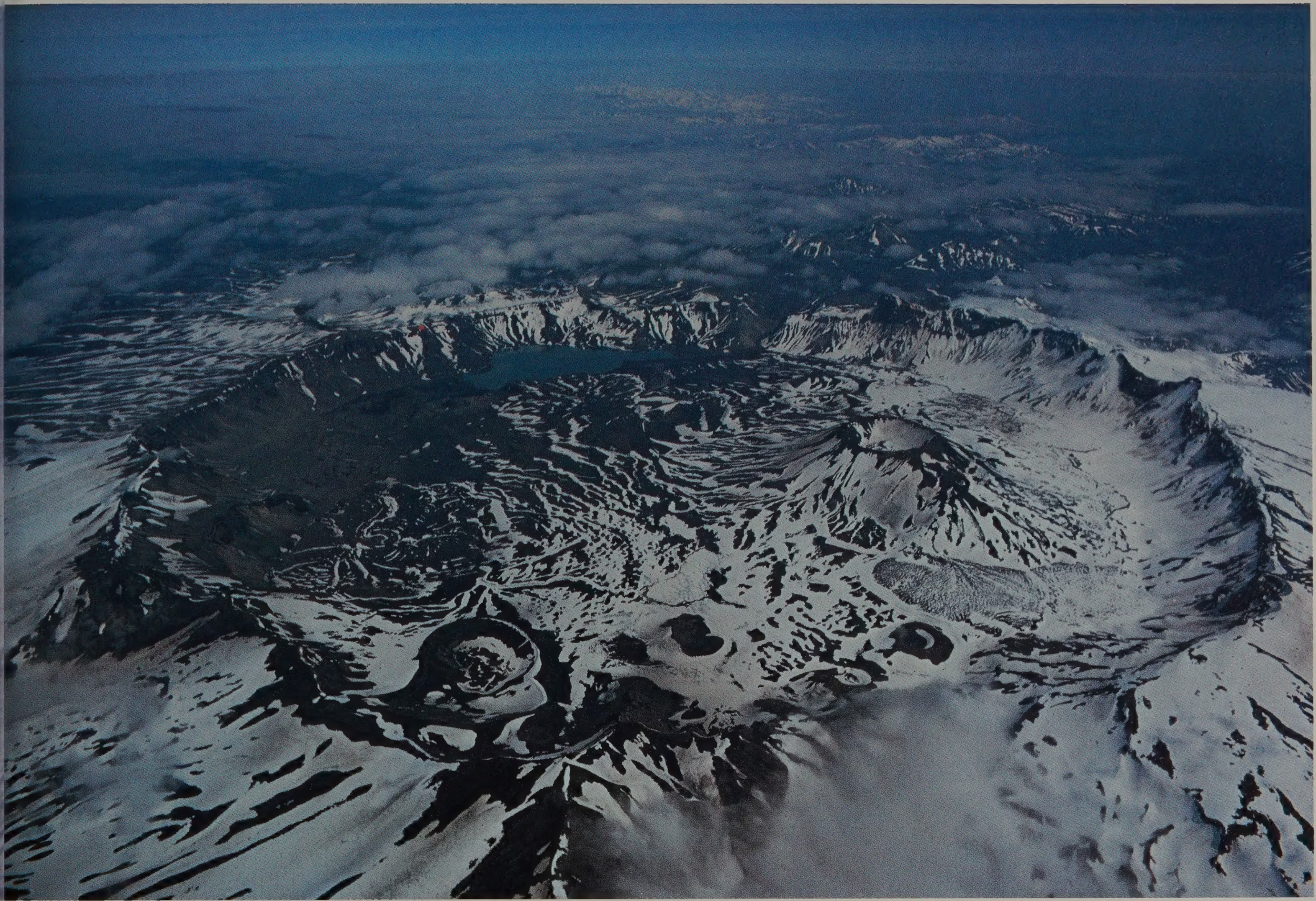
formations to be found in Alaska. A pristine recreational waterway, its steep bluffs are nesting habitat for the endangered peregrine falcon. The Yukon corridor shares remnants of Gold Rush history with Canada. Sway-roofed cabins and rusting equipage recall hardy goldpanners and days of the Klondike and the big strike in the nearby Fortymile Basin.

Almost 500 miles to the northwest, the Noatak River has already achieved international stature. It has been designated as a "Biosphere Reserve," part of UNESCO's Man and the Biosphere program of worldwide reserves. The Noatak has also been cited as the largest waterway in the Nation remaining undisturbed by human activity. The valley holds outstanding communities of arctic flora and a textbook example of geologic succession. As a recreational wilderness river, the Noatak is unsurpassed.

Just as Alaska is our last frontier, so too was it our first. During Late Pleistocene times, some 20,000 years ago, the State was linked to Asia by a land bridge that reached 900 miles in width. Across this bridge came an early people in search of wild game. And thus began an unknowing journey to the New World. The proposed Bering Land Bridge National Preserve holds remnants of this passage, as well as fossil remains of early creatures contemporary with the epic journey. All of the indigenous Indian peoples of the Americas can trace their origins to this crossing.

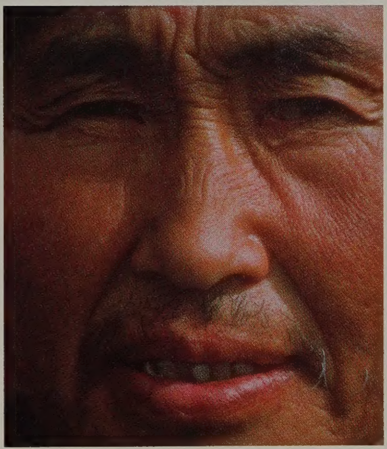
Nearby, Cape Krusenstern's series of 114 ancient beach ridges hold archeological records chronicling every major period of Eskimo history. From the Denbigh Flint people of 4,500 years ago, each succeeding culture would use the cape's outermost beaches for the hunting of marine mammals. Keeping with this long and unbroken tradition, the Inupiat Eskimo people of Kotzebue Sound still venture out each spring on dangerous ice floes of the Chukchi Sea to hunt the *oogruk,* or bearded seal.

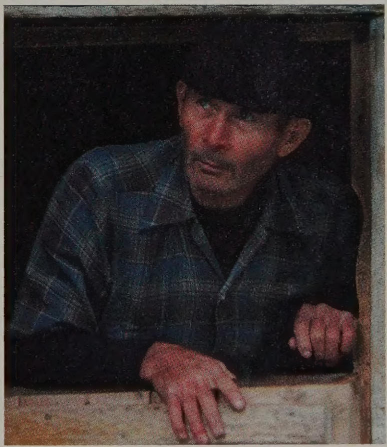
Some 100 miles inland, the gentle Kobuk River meanders past 25 square miles of Sahara-like sand dunes above the Arctic Circle. Plant communities from ancient arctic-steppe tundra still thrive in a climate approximating Bering Land Bridge times. At a river bend and caribou crossing known



iakchak Crater is six miles across.

Faces of The Great Land





as Onion Portage, archeological evidence tells of human occupation for the past 10,500 years. Combined with Cape Krusenstern's ancient beach ridges and the relicts of the Bering Land Bridge, the three proposals of northwest Alaska comprise a cultural resource of both national and international significance.

Just a three-hour drive from the State's major population center at Anchorage, the spectacular Kenai Fjords blend a rich marine environment of whales and seals and clownish sea otters with a startling lesson in geology. Located at the interface of massive tectonic plates, the resulting action demonstrates how a mountain range is slowly being folded into the sea. Tidewater glaciers, arches and sea stacks round out a picturesque classroom for tomorrow's visitor.

In sight from Anchorage across Cook Inlet, the mountains and waterways of the proposed Lake Clark National Park combine spectacular peaks and thundering waterfalls often called "the Alps of Alaska."

And far out on the Alaska Peninsula the collapsed volcano Aniakchak Caldera is a chilling reminder of the tortuous beginnings of our planet. Six miles from rim to rim, the walls of this giant shell rise more than 2,000 feet above its ashen floor and encompass several smaller vents. Vigorous forms of pioneer plantlife are gaining a foothold across a moonscape of cinder and ash. An emerald-colored lake provides floatplane landings within the crater. And a giant cleft in the crater's rim allows egress via the Aniakchak River which flows to the Pacific Ocean 27 miles away.

There exists no match in our Nation for Alaska's wildlife resource. The proposed system of Wildlife Refuges is designed to do justice to this unique legacy. An addition of 10 million acres is proposed for the existing Arctic National Wildlife Refuge along the Canadian Border. Amid some of the most spectacular mountain terrain in the far north, the refuge offers a rich pageant of wildlife, including muskox, wolves, polar bear, grizzly bear, wolverine and 140 bird species. It embraces the vital calving grounds for the international Porcupine caribou herd estimated at 120,000

Traditional transportation is being supplanted by aircraft, snow machines and motorboats, but dog teams still compete in cross country competitions recalling earlier days.

Arctic caribou herd in fall migration near Howard Pass, Brooks Range.

animals. Each spring, in restless, tide-like migrations, the herd moves northward from winter lichen pastures to the foothills and coastal plain of the refuge, which are their ages-old calving grounds. This awesome animal migratory spectacle has been compared to that of Africa's Serengeti Plain.

Alaska's forested interior lying between the mountain barriers of the Brooks Range and the Alaska Range comprises a rich "sun bowl" and provides some of the finest waterfowl breeding habitat in the world. A series of proposed refuges across the State's interior would protect the best of these habitats. Leading the system is the Yukon Flats, which ranks among the most important in North America. Nesting densities in the Flats is greater than any other area of similar size in Alaska. The annual fall flight of 2.1 million ducks includes 15 percent of the continental population of canvasback and over 16,000 geese contribute to all major flyways on the continent. During drought years on the prairies of Canada and the U.S., the Yukon Flats and other "sun bowl" habitats act as a vital safety buffer for displaced waterfowl. Accompanying the Yukon Flats are important marsh and pothole regions which will add to our National Wildlife Refuge System such exotic names as Koyukuk, Innoko, Tetlin, Kanuti, Nowitna, and Selawik.

Rimming the State is a marine bird resource approaching several hundred million birds—murres, kittiwakes, puffins, petrels, and other pelagic species. In a system of offshore rocks, islets, spires and headlands comprising 460,000 acres, a coastal marine refuge is proposed which would protect the critical habitat of up to six million seabirds, or approximately 20 percent of the State's total. Additionally, they would also include 22 percent of Alaska's 140,000 sea otters, only recently back from the edge of extinction; and 20 percent of the state's 215,000 sea lions.

Along the Alaska Peninsula a proposal for a 1.5 million-acre wildlife refuge is estimated to contain over 2,000 brown bears, as well as moose, marine mammals and migratory birds. The peninsula's bays and lagoons hold the entire world populations of black brant and emperor geese

Traditions of an ancient culture persist in Alaska's north country. Here is an Eskimo family crossing the spring ice, searching for bird eggs near Cape Krusenstern.

during fall migration. Lying to the north along Lake Becharof, a 1.9 million-acre refuge contains many salmon streams and some of the richest brown bear habitat known. As many as 100 bald eagles also share the same salmon streams during fall.

Completing the proposed system of wildlife refuges are two areas in the southwest quadrant of the State. Togiak would protect important migratory bird staging areas for three major flyways and four continents. At least 32 species of land mammals occur in the area, ranging in size from the shrew to the brown bear.

North of Togiak lies the highly productive Yukon Delta. Along its sloughs and ponds and backwaters there emerges each year nearly all the white-fronted geese of the Pacific Flyway, more than half of the continental population of black brant, and at least 80 percent of the world's emperor and cackling geese. The annual fall flight from the Delta averages 2.3 million waterfowl. The shorebird breeding population exceeds 100 million, which includes the entire world population of bristle-thighed curlew.

Combined with 33 of the finest recreational rivers, the proposed parklands and refuges represent the best of the best remaining in our Nation—or, "the crown jewels," in the words of Secretary Andrus. Wherever possible, boundaries have been adjusted to avoid conflict with areas of petroleum or mineral potential, and follow watershed lines so that integrity of natural systems is not lost. Self-sustaining resources was the goal, rather than acreage alone.

The plan is bold, to say the least. But not a costly one. At a time when our Nation has invested hundreds of millions of dollars to save the few remaining acres of precious open space at such places as Point Reyes, California, and the last of the great trees at Redwood National Park, the cost in Alaska pales by comparison. The lands proposed are already in public ownership and thus require no expenditure for acquisition. Tomorrow's parklands and refuges and wild rivers need only designation by the Congress. Such an act would usher in a new age for Alaska, to the lasting benefit of all Americans.

In Partnership with Youth

Clearing snow off the roof of the Canyon Visitor Center at Yellowstone are Karla Kovash, Jeff McMaster and Janice Farrell.

By Margaret B. Hushelpeck

AMID THE BEAUTY of nature and splendor of the great outdoors, over 22,000 young adults are at work this year under the Youth Employment and Demonstrations Project Act of 1977. The Young Adult Conservation Corps (YACC) was designed to help unemployed young men and women between the ages of 16 through 23 to perform meaningful conservation work and assist in completing other projects of a public nature on Federal and non-Federal public lands and waters.

YACC is designed for the young unemployed who cannot find jobs or continue their education. It's a partnership between young people who need jobs and a government that needs their talents, their energy, and enthusiasm. Corpsmembers are paid the minimum wage of $2.65 per hour.

On United States public lands, in an agreement with the Department of Labor, both Interior and Agriculture are operating residential and nonresidential camps through Agriculture's Forest Service and Interior's National Park Service, Bureau of Land Management, U. S. Fish and Wildlife Service, Bureau of Indian Affairs, Bureau of Reclamation, and the Office of Territorial Affairs.

In Virginia and North Carolina Young Adult Conservation Corps members perform a variety of tasks along the Blue Ridge Parkway.

Funds have been allocated to the 50 States, the District of Columbia, Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Trust Territory of the Pacific Islands by the Departments of Agriculture and Interior for conservation work on public lands.

Typical of the YACC program within the Department of the Interior is National Park Service nonresidential Camp No. 2172 operating out of Roanoke, Va., along the Blue Ridge Parkway. It is the first Park Service camp to be operational, beginning October 1, 1977. Richard Stokes is the Project Manager. Under his guidance and that of Camp Director Harold Spencer and Work Coordinator Frank Leonardo, seven work locations were set up: Vinton, Montebello, James River, Peaks of Otter, Rocky Knob, and Fancy Gap in Virginia, and Asheville in North Carolina.

Each location has a work leader and may have anywhere from 10 to 25 corpsmembers. There are over 160 enrollees at the Blue Ridge Parkway Camp from all economic backgrounds. They may participate in YACC for up to 12 months, and were recruited through the State Employment Agency from neighboring communities in Virginia and North Carolina.

A devastating ice storm struck the Parkway Easter weekend which deluged the roadsides with uprooted trees, broken limbs, and twigs. Work crews were put to work with chain saws removing broken tree limbs; the brush and limbs had to be hauled to the side of the road. Then the "chipper," a mechanical device for grinding up the limbs and branches, moved in. Crews were kept busy feeding the chipper which spewed out the chips and sawdust back into the forest. The chips help to provide mulch and prevent undergrowth.

Spring also is clean-up and spruce-up time along the Parkway. Hundreds of bags of litter are collected. Crews compete with one another to see who can collect the most. There are fences to be mended, signs to be erected, paths to be cleared, and a hundred and one things to be readied so that nature will show forth her beauty in the best possible light.

Winter snowstorms and chilling rains force many work crews indoors. A variety of indoor community projects kept the James River crew busy. At Big Island, Va., corpsmembers painted the inside of the local firehouse and the rescue squad room, washed and waxed all firetrucks, and insulated the ceiling of the rescue squad room. They also painted the Bedford Sheriff's Office.

Motivating these young adults is a prime project of YACC. Hal Spencer and Frank work that will help them along the way to place the corpsmembers in meaningful work that will help them along the way to their future careers. Let's meet some of them:

Warner Williams is a graduate of East Tennessee State and wants to be a Park Service technician in law enforcement. So he was put to work assisting a Park Ranger. The first night Williams came on board, he was out with an all-night search party looking for a missing hiker in the Blue Ridge mountains.

Beth Neighbors dropped out of high school but now she wants to become a secretary. She was assigned as a receptionist in the administrative office at William Byrd High School in Vinton. She goes to school three nights a week to complete her education. YACC also has two custodial aides working at William Byrd High.

Emily Harvey is from Trenton, N.J., where her father, who is going blind from an accident, has an environmental business. She has some education in engineering. Emmy is thinking of going back to further her education so that she can take over and help in her father's business. She is now an engineer's helper, reading blueprints and construction plans, and she can drive a big truck, too.

Wiley Brooks is fortunate to be learning a new trade. He has worked as a carpenter helper and welder, but now he is helping Ray Shaw, a Park Service sign painter at Vinton. They make signs for the Blue Ridge Parkway, working with redwood and woodworking equipment. He is learning metal engraving and how to use a router tool.

At the James River location, Roy Miller is work leader. He is anxious to become a Park Service Ranger. He has worked five years as a seasonal Ranger at the Delaware Water Gap National Recreational Area and has been Physical Education and Driver Education Teacher, as well as Wrestling Coach, at East Stroudsburg High School in Pennsylvania.

Chuck Lynch from Salem was student

newspaper editor at Andrew Lewis High School, and studied journalism at Darrington College in Tacoma, Wash. Even though he has been assigned to doing carpentry and using small hand and power tools, he is developing a newsletter for the YACC camp.

And there is Durwin Bonds. He's had management and accounting training at business colleges in Roanoke and is studying to be an accountant. Durwin was put to work in the YACC office in Roanoke where he does the payroll, checks computer printouts, and is helping with the inventory of equipment, tools, and clothing.

The enthusiasm on the faces of these young adults is magnetic. They are doing a good job and liking it. They feel needed. Even Ann Morris, after only three days on the job, was smiling as she dragged along with blisters on her feet. Her first few days were with a chain saw crew hauling brush to the roadside.

Down on the North Carolina end of the Parkway, you could come across a crew helping to lay prefab turf blocks. The blocks are installed next to the roadbed and then turf is laid over them so that there is a firm shoulder when a car stops off the pavement.

Further up the Parkway between Asheville and Roanoke, another crew can be found assisting the Park Service in dismantling the greatly deteriorated Garst Mill Cabin, dating to 1825. Inside wall logs of pine and oak that appear sound are

YACC members work on road crews, engines, directional signs and clearing dead pines along the Blue Ridge Parkway. Left, Beth Neighbors is training as a high school receptionist.

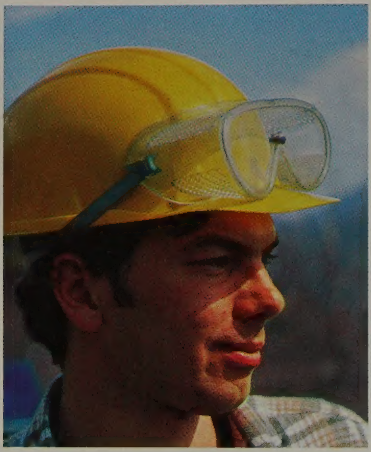
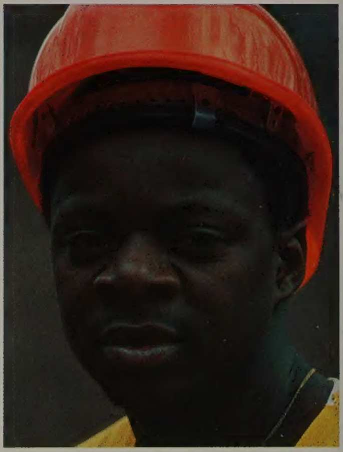
recycled for restoration work. Parkway personnel reclaim all usable logs, treating them for preservation purposes and using them to repair cabins that the Service maintains.

Our partnership with youth continues in other parts of the country and in other Interior Bureaus.

In the Bureau of Land Management (BLM), as part of the regular work force, YACCers may work individually—servicing signs, maintaining warehouses, doing timber stand improvement work, or other activities necessary to manage the public lands.

Crews are at work in Eugene, Coos Bay, Roseburg, Salem, and Medford, Ore. Tree planting is one activity suited to organized crews, and BLM chose the more difficult-to-plant spots for the flexible crews to accomplish. On a steep slope near Horton the objective is to get another crop of seedlings growing as soon as possible after timber harvest. Tough sites make judgment important to insure tree survival. The planters look for logs or rocks to shelter seedlings planted on hot, dry, south slopes.

Zuni YACC of the Bureau of Indian Affairs gained unique experience through participation in a flood alert in early 1978. Streams above Zuni, N. Mex., threatened flooding in the Pueblo of Zuni. YACC Director Donald Sharp called his four crews into action. During the entire weekend alert YACC volunteers helped with sand bagging, kept vehicles ready for evacuation,

and disseminated "flood-ready" information to residents, helping to prevent rumors and panic. Crew members were commended for being cheerful and pleasant. They worked consistently and diligently, whether it was in the daytime or the wee small hours of the morning.

By the end of 1978 the Bureau of Indian Affairs will have 16 camps in operation, mostly nonresidential, with over 1,450 enrollees.

Bureau of Reclamation corpsmembers are benefitting from work-learning experiences in a variety of fields including drafting, surveying, hydrology, office services and maintenance. At Cortez, Colo., they participate in archeological work, while at Page, Ariz., they are involved in electrical and mechanical maintenance work at Glen Canyon Dam. There are gullies to be plugged to prevent erosion, grasslands that need to be reseeded, and trees to be pruned. In the Ephrata-Moses Lake Area in the State of Washington, corpsmembers are at work cleaning up old buildings on homesteads where they salvage materials to build miles of fences. Other work includes improvements at parking areas and spring shrub planting to improve the wildlife habitat.

In the far Pacific, the Office of Territorial Affairs has a YACC camp on Palau. Enrollees have helped to build a nature trail to remote Jellyfish Lake in the limestone section of Koror in Palau District. The trail passes the Yapese stone money quarry which in the past could only be reached by boat. It continues through scenic lookouts, a valley with virgin timberlands, and limestone bat and swiftlet caves. The Palau YACC program is directed by Timarong Sisior.

By the end of 1978, the U. S. Fish and Wildlife Service expects to have over 2,000 enrollees at 23 YACC camps, with 170 satellite locations. At the Back Bay Camp, Virginia Beach, Va., 10 to 15 enrollees had a new learning experience when they helped the U. S. Coast Guard during an oil spill in the Reedville area of the Chesapeake Bay. A barge was on its way from Norfolk, Va., to the Patuxent Naval Air Station with 25,000 gallons of oil when it became grounded. Corpsmen helped to rescue whistling swans, mallard, canvasback, and golden eye ducks. Other projects of the Back Bay group involve installing fences to help build up sand along the beaches, clearing old home sites, and building boxes for wood duck nests.

At the Olympia, Wash., camp YACCers help with enforcement and assist in salmon fishing research in the Columbia River by netting fish and helping to take the fish census.

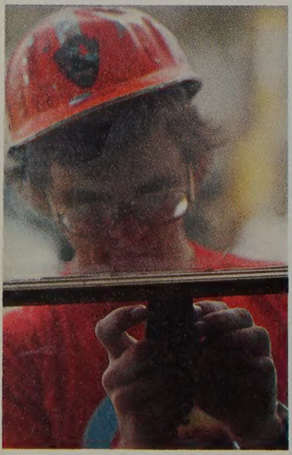
U.S. Geological Survey does not have any YACC camps but it is participating in the program by furnishing work projects to other Interior camps in their areas of operation.

There are other youth work programs within the Department of the Interior. Not to be confused with YACC are the Job Corps and Youth Conservation Corps (YCC).

Job Corps offers disadvantaged youth between the ages of 16 and 22 years the opportunity to learn a trade and improve their education so they will have a better chance for rewarding jobs and a successful future. One of Job Corps most valuable accomplishments is its remedial education system. The typical youth it serves is an 18-year-old high school dropout who reads at the elementary school level, comes from a poor family, belongs to a minority group, and has been unemployed for many weeks or has never held a job. The Department of Agriculture, along with Interior, participates in the program. Many trade unions are active in offering preapprenticeship training of corpsmembers. The aim is to help youth become responsible adults, prepared to obtain and to hold productive jobs, return to school or further training, or satisfy Armed Forces entrance requirements.

Youth Conservation Corps furthers the development and maintenance of the natural resources of the United States by employing, in the summer months, youth between the ages of 15 through 18 in a healthful outdoor environment. Teen-agers work primarily to upgrade outdoor recreation facilities on public lands. There are residential camps where the young people, eat, sleep, and work at locations away from home and nonresidential camps where the youngsters work in the area where they already live. Besides the 30-hour work week, they put in 10 additional hours of environmental education activities weekly. Most projects are coeducational, with equal numbers of young men and women taking part. Hard work and good times—that's YCC.

Yes, America's youth are alive and well.



TOMORROW'S MANAGERS

The Departmental Manager Development Program (DMDP) gives potential middle managers leadership training in a 10-month Washington-based program. Candidates from all Interior agencies compete for 25-30 positions each year. Those who are chosen arrive in Washington in September from Interior stations all over the country.

A recent group brought together a Pueblo Indian school principal from New Mexico, a wildlife biologist from North Dakota, a black chemist and equal Employment Opportunity officer from Pittsburgh, a National Park manager from Massachusetts, a female realty specialist from Oregon, and a recreation planner from Colorado, among others.

At first they seemed to have little in common, but as the orientation proceeded, it became obvious that large issues of resource management and human development involved them all. Interior managers face many of the same problems whether operating a park or a coal mining area, such as how to protect the land and its long-range values while allowing resources to be developed, when to deny a desired public use, how to get public ideas on such decisions, and how to budget for tomorrow's needs.

The manager-trainees spend weeks in studying legislative functions, budgeting, labor-management relations, public administration, conflict resolution, personal development, and time management. In addition to formal courses, they gain practical experience in one-to-three month assignments outside their home agencies. Usually a trainee will spend several months on Capitol Hill working for a committee or a Congressman and will also spend a month or more in several other agencies and in one of the Departmental offices.

Late in the year the group plans and carries out a two-week natural resources seminar. The seminar theme was resource use versus conservation as the problem is faced by Interior Bureaus in the field. The seminar looked at Montana-Wyoming where nine Interior bureaus face problems of mutual concern in energy development, land use planning, wildlife, recreation, and trust responsibilities for Indians.

By the end of the 10-month period, potential managers have a much broader concept of the Department's work and the place of their agencies within it. They are trained to understand the legislative and budgeting processes and gain a better perspective of how to accomplish their assigned tasks. —*Margaret Osborne*

AS I SEE IT:

ONE MAN'S ENVIRONMENT

I LIVE IN AN old farm house which by modern standards is difficult to heat. Perhaps earlier owners were content, being of hardier constitutions than this generation. Or they kept warm by constantly cutting firewood. In any event, some owner grew tired of this procedure and installed an oil furnace for heating steam radiators.

The system still works fairly well. However, there are times when it is best to crawl into a tub of hot water drawn from the balky furnace. Recently, this relaxed state induced a message from the past.

In a cloud of steam, I realized that in essence I was steeping in the warmth of a sun that lighted the first reptiles some 300 million years ago. Through technology, that ancient sunlight trapped by plants-turned-to-oil was warming my twentieth century tissue.

On these terms, I could not complain about living in this kind of environment, even though someone had "cut Mother Earth" to get at the oil. In my mind there seemed to be a wonder to this existence that the strident voices of today may have overlooked. Could we, I mused, in effect be a helpless extension of that ancient environment, one predestined to invent oil furnaces and rattling steam pipes?

If so, then the ancient environment programmed the future of which both environmentalists and industrialists are cut of the same terry cloth.

Certainly, our antecedents were tool makers — industrialists — and often quite clever. Up until modern times, survival demanded such a lot. Only in our advanced technology could man afford the luxury of dropping his toolmaking for the detached profession of the environmentalist. Ironically, industry made this possible, and not too soon—for its own sake.

Perhaps the ecologist-environmentalist reflects man's capacity for survival. For this sensitivity is of necessity becoming the conscience of industry.

The monstrous boredom of youth, the decaying inner cities, the unplanned thrust of technology across fertile lands and wilderness areas, speaks of good turned malignant. This vector of destruction could well be the sin of greed. The threat comes upon an assumption that man is above the needs of the environment.

How could this be when all evidence points to humble beginnings in the matter of things, living and dead?

The ancient environment touches all alike, whether a plastic punch press operator or a scientist sampling a pristine stream. The fossil energies produced the amenities by which the research could conjure a computer report on saving the stream; they also fuel the economy upon which the punch press operator's job depends.

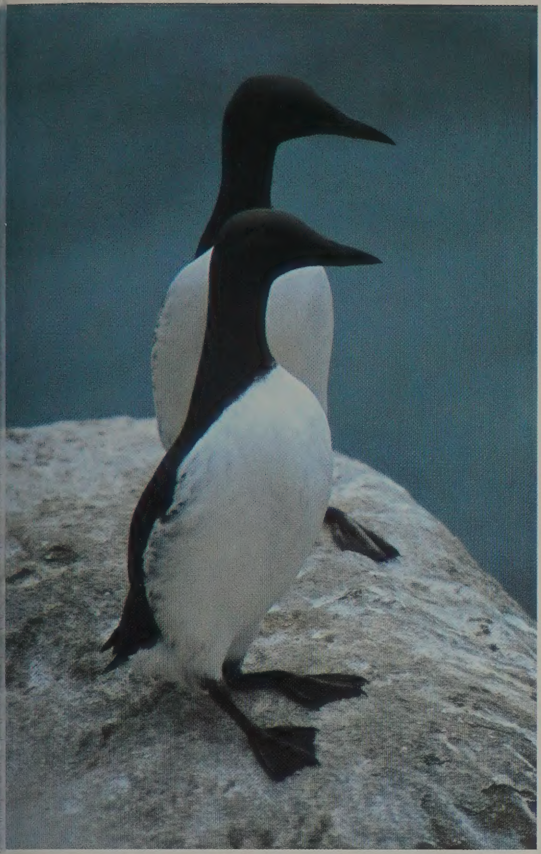
In effect, the ancient environment affects with one positive accord. Is it not strange, then, that the same basic energy from the sun produces such dissension today—environmentalist pitted against industrialist, such as on the Alaska frontier? Would it not be wiser for the environmentalist to become a bit of an industrialist and thus share one another's strengths? The industrialist needs the environmental ethic for his own survival, if not all others; and the environmentalist needs the pragmatic wisdom of the industrialist.

Somehow these terms came to agreement in a hot bath, drawn from a prehistoric world. For a moment it seemed unnecessary to even consider the question of "Living with our Environment."

—*M. Woodbridge Williams.*

California's Point Reyes

The City Wilderness



By M. Woodbridge Williams

How can it be? How can a wilderness thrive within the sky-glow of a vast metropolis? Yet Point Reyes National Seashore lies only 30 miles from San Francisco, the closest Federal wilderness to a city within the United States. Here in Marin County, California, the park stands unique among cases where the words "wilderness" and "city" often reflect a contradiction in terms.

Serving close to five million people who live in nine counties surrounding San Francisco Bay, the land spreads ripe for development. Look at the assets:

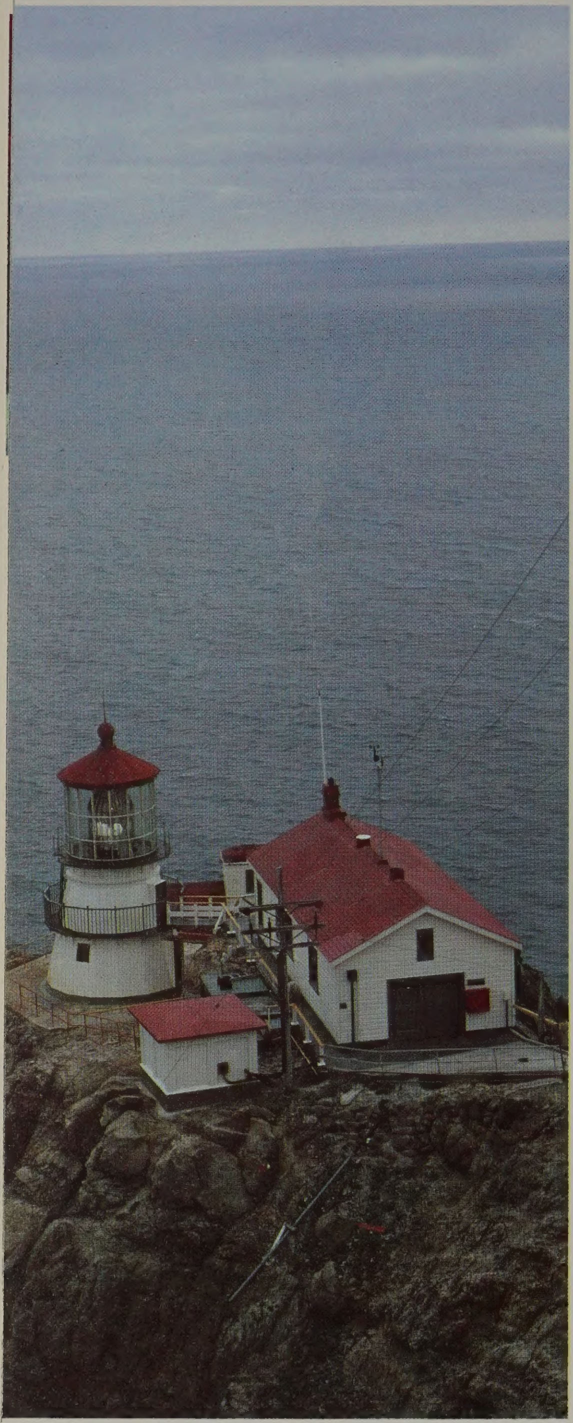
Wild beaches and estuaries, massive headlands, lush moors, high ridges flanked by deep forests, fern-lined canyons, and coastal hills studded by small lakes. This varied terrain supports, on occasion, 380 species of birds and nearly 100 mammals, not to mention the sea life, burrowing, slithering, and encrusting a pristine littoral. Above the tide, gardens by the sea carpet the land. Rock and dune house flora from north and south as well as 12 endemics and 17 endangered species.

Bounteous in game, plants, and sea food, Point Reyes offered the first settlers, the Coast Miwok Indians, a total energy system, which they wisely neglected to "improve." Subsequent intruders marked the land, but for the most part the wild character sings intact, even to those who covet such real estate.

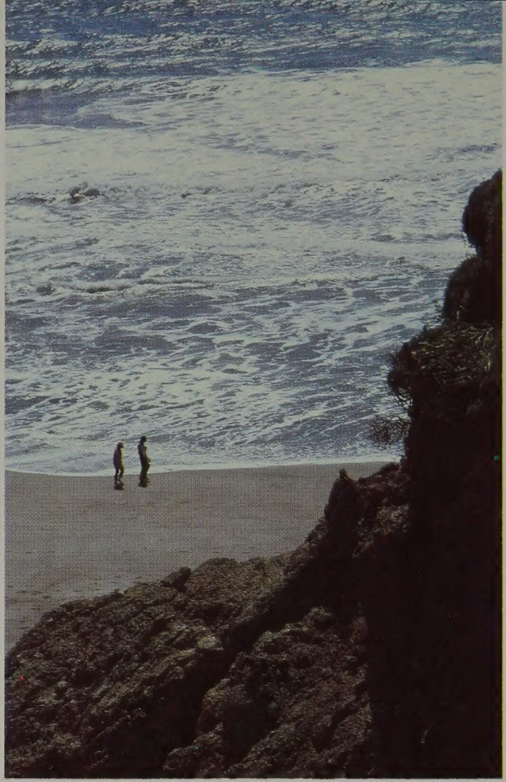
Here Francis Drake, who visited somewhere in the area in 1579, would feel much at home, for the tawny bluffs of Drakes Bay inside the Point stand, today, unmarred, and remind us of Drake's cliffs of England. Thus history joins hands with nature in writing the Point Reyes scene—sometimes violently.

Jack Mason, former editor of the Oakland Tribune, mentions in *Point Reyes, The Solemn Coast,* the fierce hogs on the Point that would challenge a visitor to the ranches. Then he described the "Clausen cats," ferocious escapees from a shipwreck, which were once exported to San Francisco to put down an uprising of rats in a Sansome Street warehouse. These descendants of the wreck of the Warrior Queen quickly completed a job too tough for city felines; then, perhaps bored, one member stalked up Market Street and entered the Palace Hotel lobby. With teeth bared, this leering swashbuckling cat charged among the startled people, then climbed the gold drapes, only to be shot, thus terminating this touch from the wild Point. Truly both natural and human storm swept this land.

Skippers with navigational problems left some 50 recorded wrecks on beaches and rocks, the earliest being the San Agustín, a Manila galleon, which broke anchor in



a storm and washed up on Drakes Beach in 1595. By 1870 a lighthouse stood on the knife ridge of the Point, 300 feet above the sea. Although traffic was slowed ashore, the air was not secure. A United DC-3 ditched off the Point in 1938. But not affected by navigational error was the annual migration of Grey Whales which pass close to the Point coming and going between their breeding grounds in Mexico and feeding grounds in Alaska. Although once whaled to near extinction, the Greys survived better than the Mexican-American owners of the original land grants on the Point. The largest was called Rancho Punta de Los Reyes, about 35,000 acres. The names Garcia, Berry, Briones, and Osio are linked with these original cattle ranches. They might have held them through the American takeover of California in 1846, but for a game of musical lands in which three of the landowners moved to unoccupied land belonging to neighbors, thus



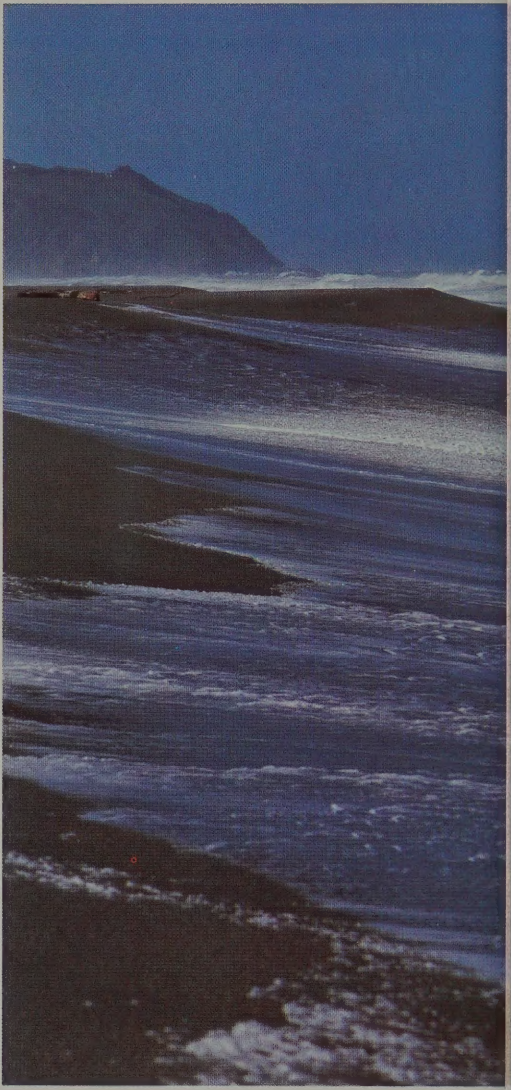
setting the stage for questionable titles and contentious suits.

A family of shrewd Vermont lawyers named Schafter eventually picked up the pieces and gained control of the entire Point Reyes block from Tomales Bay to Bolinas Lagoon. They held control for 60 years, with the exception of Tomales Point which they sold to Solomon Pierce in 1858.

Rented to tenants, the Point became a butter churn for San Francisco, the moors proving ideal for dairy farming. Packed 55 rolls to a stout wooden case, the butter was shipped out of Drakes Estero by small schooners to San Francisco where it received acclaim in the city's splendid hostelries.

Following World War I, tenants bought up many of the ranches. Legend holds that the land was sometimes deeded in lieu of wages. Legends also abound concerning the liquor traffic across the Point during prohibition. Some say it came across the land for a passage fee of a dollar a case from rumrunners unloading in Drakes Bay.

Today dairying continues on the Point under the provisions of the Seashore Act. There dairies add historic interest to the wild scene, and, no doubt, grazing over the years has determined the vegetation on the



moors. It has, perhaps, enhanced the growth of the large bush lupine that fill May with perfume. Precedent for such "inholdings" on Point Reyes has its roots in the Cape Cod National Seashore Act, which provided for private holdings within a Federal domain, a development in national park legislation that come of lands long occupied by human activity.

Beside dairying, RCA and Bell Telephone operate receivers on the Point, and a fishing industry carries on in Drakes Bay. Finally, an oyster industry flourishes in

Drakes Estero. Its founder was a Pat Quayle, a scientific artist from UCLA, who first seeded the lagoon in the '30's. He told me in 1935 that while sowing spat in Creamery Bay, an arm of the Estero, ranchers stood on the bluffs and fired at him with .22 rifles. Such was the independence of this wild land, yet so close to a big city.

Up until the 1950s, the elements of rugged terrain, benign neglect, and large tracts held in private ranches combined to preserve this "Island in Time," as the Sierra Club calls it.

Understandably this close-in open space offered prime targets for urban sprawl. World War II veterans settling on the fringes of the future park, such as Inverness on Tomales Bay, led to a new discovery of the land. Aggressive realtors followed. By 1956 homes loomed on wild Limantour Spit, a sand beach on Drakes Estero. At this point conservationists took stock. The land which the Miwok neglected to improve now appeared headed for annexation by bedroom communities on San Francisco Bay.

Back in 1935, Conrad Wirth, former Director of the National Park Service, recommended that 53,000 acres of Point Reyes be established as a National Seashore. This report slept for 27 years until the development crisis on the coast welded local and national conservation powers in an all-out effort to save Point Reyes.

On the Hill, the late Clem Miller, Congressman, First District, led the political coalition. The Secretary of the Interior, Stuart Udall, orchestrated the cymbals. In 1962 Congress authorized the Seashore and shortly thereafter approved five million dollars for land acquisition, only a drop in the bucket compared to the estimated total cost of over $57 million for 65,263 acres of park land; but in 1976 almost the entire coast strip, some 25,370 acres, came under the Wilderness Act, a far cry from the recreational master plan first proposed by the National Park Service. Local pressures, headed by young people, who had moved to the area in the 70s, forced the Service to rewrite its master plan with more emphasis on wilderness preservation. The results are unprecedented.

On the east and south of the National Seashore, additional lands came under the government wing when the Golden Gate National Recreation Area was established in 1972. Thus a continuous protected shore extends the length of Marin County, forming the single largest Federal parkland in urban America.

The sea carved Point Reyes from ancient coarse granite, which forms a unique geological block quite separate in history and structure from the mainland. The San Andreas fault divides the Point from the continent, and along this fault Point Reyes is estimated to be sliding northwestward at the rate of two inches a year. Tomales Bay lies in the fault depression, while grassy hills roll across the mainland. In contrast, the Inverness Ridge on Point Reyes supports the southernmost stands of Douglas fir, and botanical islands of Bishop pine, remnants of an Ice Age forest.

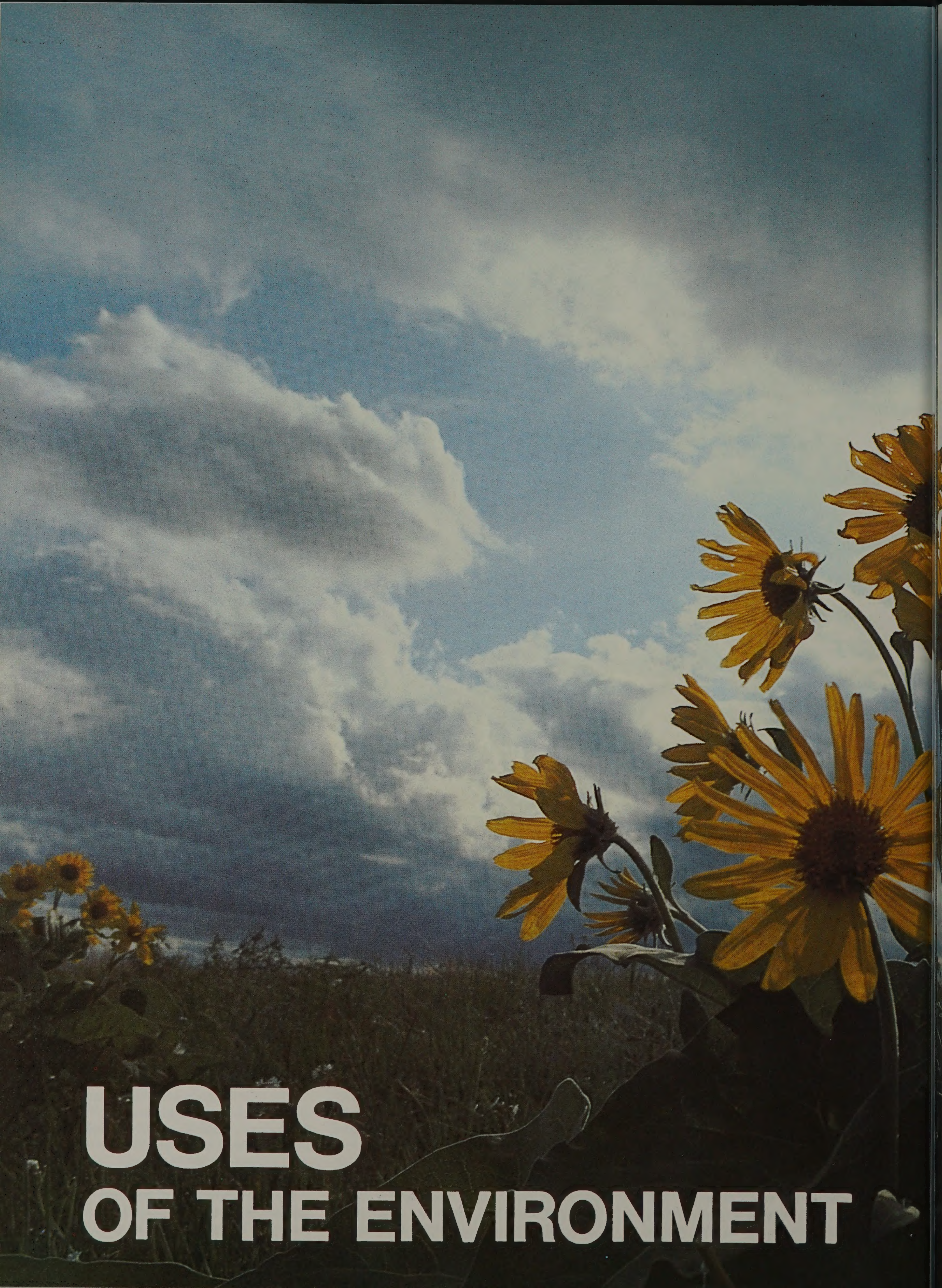
Fog sweeps the land; wind blows incessantly. Wildflowers dance in the gusts. Yes, Point Reyes is another world.

The late Walter Mathews, manager of the RCA receiver, once told me: "When I first came to Point Reyes from Long Island, I put in for overseas pay."

"Did you get it?" I asked.

"Nope, but I should!"

But we know that there can be a city wilderness by the Golden Gate—now that the Point belongs to the mainland.



USES
OF THE ENVIRONMENT

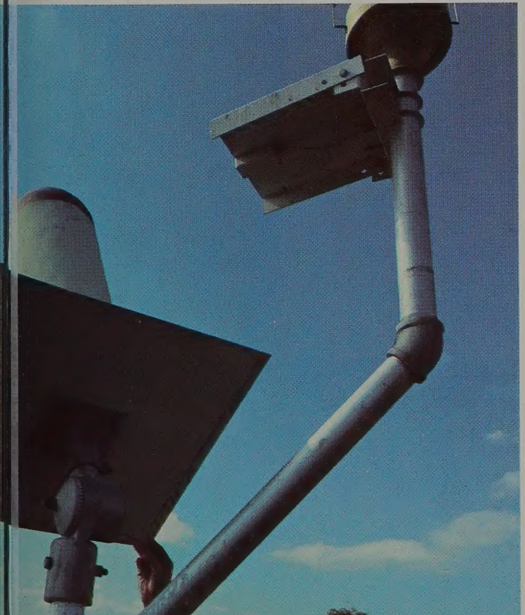
Chapter II

The Okeechobee Connection

Aerial views (left page) show the Everglades region of south Florida both in drought and in flood. At top right is a canal dug some years ago to drain agricultural areas south of Lake Okeechobee, dispersing water now known to be vital to the survival of Everglades National Park.

Typical of developments in the Big Cypress region are these homes on drained land (above) and this grotesque private airport development on the east-west Tamiami Trail.

Below is a transmitter sending rainfall and water flow data to satellites which provide a continuous source of information to a USGS computer near Washington, D.C.



By Jean Worth Matthews

WHEN SOMETHING GOES wrong with a product or a process, the cry is "back to the drawing board."

When the process-gone-awry is a great national park, the drawing board is nature, and today a handful of Everglades research scientists are earnestly reading Nature's fine print and trying to fit it into the larger picture. They are studying both the text and the context.

Put in Everglades-specific terms, this translates into a detailed study of the plants and animals of the Everglades, and a wider look at the matter and energy systems within which this unique biological system operates.

John Good, Everglades National Park superintendent, is the science team's strongest booster. "This park was established back in 1947 because of its superb array of animal life," he says. "But you can't really manage animals; you can only manage the conditions within which they exist. We must have the scientific knowledge so that we can predict what will happen to the park if certain outside influences impinge on it."

In the case of the Everglades, the absolutely vital connection is water—specifically water from the huge, shallow inland sea called Lake Okeechobee. And it is not just the water, per se, but the *kind* of water it has become by the time it reaches the park—the *quantities* of water, and *when* it arrives, and *how* it flows into and through the park.

The plants and animals of the Everglades are its unique text; but the *con*text is water, and Everglades water has to be understood not just as a thing, but as a process.

The meeting of land and water which today is the Florida Everglades began 19 to 20 million years ago, when the limestone "highlands" of the ocean floor broke through the surface and stood above the ancient sea. The Age of Mammals was at its height; the precursors of man were just being written into the script; the ecological confrontation between South Floridians and their habitat was still aeons off in the future.

Millenium after millenium, from the Eocene Age onward, a steady downward drift of skeletons and shells—the residue of a richly-populated sea—formed the limestone base for what eventually would become a richly-populated land. What finally emerged above the water was something unique in this part of the world—a land base which stemmed entirely from the interaction of living creatures with their environment.

An overriding awareness of this vital interrelationship of land and life must permeate any prescription for the future, and it is just such an awareness that underlies the work of research scientists fighting to save the nation's most threatened park.

Today the animals of this one-of-a-kind world are in danger, and the effort to save them goes far beyond species-specific work. It goes into systems preservation; for without habitat, numbers count for nothing.

The attention to ecosystems as a whole is perhaps the most important emerging element in the National Park Service science program, and nowhere is it more crucial than in the Everglades. The key word in systems is "connections" and you don't need an x-ray machine or a dissection table to find the Everglades Connection. It's all there—right on top—in the slowly moving chain of water that begins as overflow from Lake Okeechobee and winds up as the lifeblood of the Everglades and everything within it that moves.

Hear the water experts:

"Science in the Everglades is going back to basics."

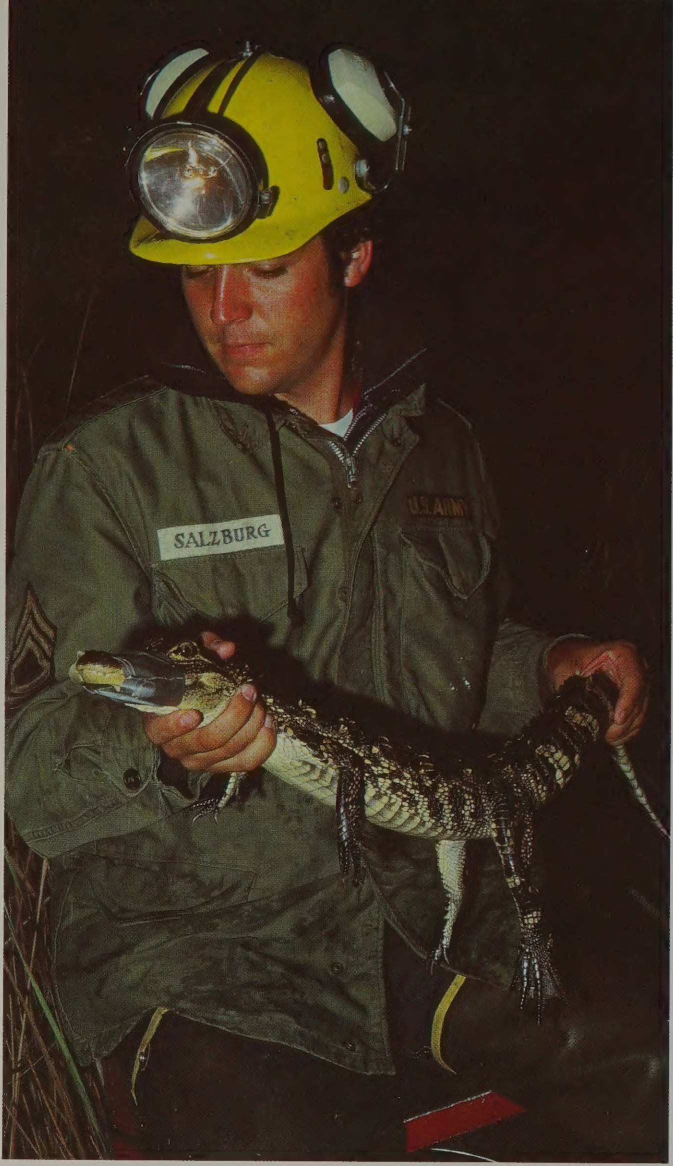
Data come from three different kinds of monitoring installations throughout the park's 1.4 million acres, including seven satellite platforms that broadcast information on water levels and water and air temperature to LANDSAT I and II. Through the satellite imagery and field studies, scientists are constructing a moving picture of the water as it flows overland from Lake Okeechobee, through the conservation areas and canals, and into the park.

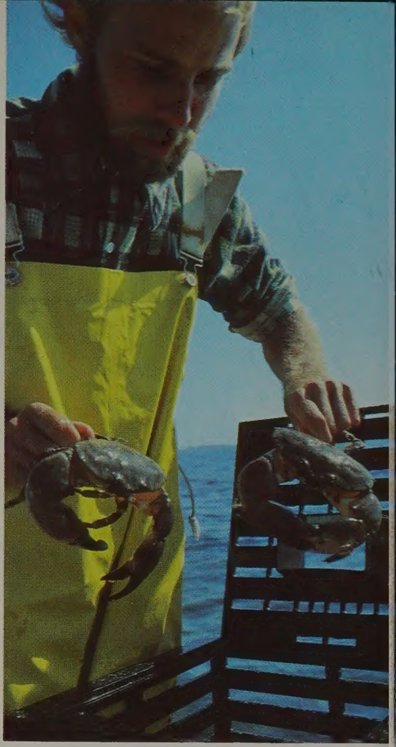
How does it enter? How does it spread out? How does it dry up?

The answers to these questions are vital to scientific management of the everglades ecosystem and the billions of life forms that hang in its delicate balance.

The Big Cypress Swamp north and west of the park, a vital link in the water chain, has been set aside as a protected, managed preserve. No further development will be allowed there to impede the normal flows of fresh water into the park.

However, the cross-Glades highway to the north—the Tamiami Trail—has effectively interrupted the historic sheet flow—an impediment that is not realistically compensated for by the "point flows" that occur through gates built under the highway. And to the south, the Florida Keys highway forms a trap for the waters of Florida Bay. Between Lake Okeechobee and the park, the water must flow through enormous agriculture and drainage systems. Housing and farm developments press against park boundaries. No longer





Scientific research at Everglade National Park includes capturing youn alligators for tagging (Mark Salzbur upper left) and studying the habits c elusive stone crabs (zoologist Do MacArthur, above).

Undisputed lord of the Everglades is th American alligator whose only predat is man (opposite page, upper right).

With wings outstretched, the magnif cent osprey, or fish hawk, glides to nesting place on Florida Bay.

can park water quality be controlled from within the park.

The loss of estuarine habitat has created a fisheries problem in the park. The character of the coastal zone has been changing rapidly from largely fresh to a more marine system, and while this saltier environment supports large, mature sea fish, it no longer provides for their nurseries.

White Water Bay northwest of Flamingo, once the Everglades estuary and historically anywhere from zero to 1.2 percent saline, has become since 1940 not just saline but hypersaline. Full strength sea water is 3.5 percent salt; White Water Bay is running as much as 4.2 percent saline.

While fishermen may rejoice yet a little longer over good-sized pompano, mackerel, mullet and sea trout, the lack of smaller fish forecasts the eventual decline of mature fish stocks.

Research is continuing, to define the relationship between fresh water management and watershed management and to study how manipulation of vegetation patterns relate to the slow-down of water flows and the reestablishment of conditions that held sway when the park was legislated.

Buttonwood Canal, cut between Florida Bay and White Water Bay to provide boat access, has contributed heavily to the hypersalinity of the former estuary. The Park Service and the Corps of Engineers now plan to plug the canal in 1979, theorizing that this may reverse the saline trend and perhaps, eventually, restore White Water's function as a freshwater aquatic nursery.

The best way to manage the water, goes the consensus between scientists and the superintendent, is to return the park as nearly as possible to the conditions that would have prevailed had the system not been the subject of massive human tampering. A further goal is to accomplish this with the least management-intensive measures. This, in its way, translates into "use the sun wherever you can instead of resorting to fossil fuels."

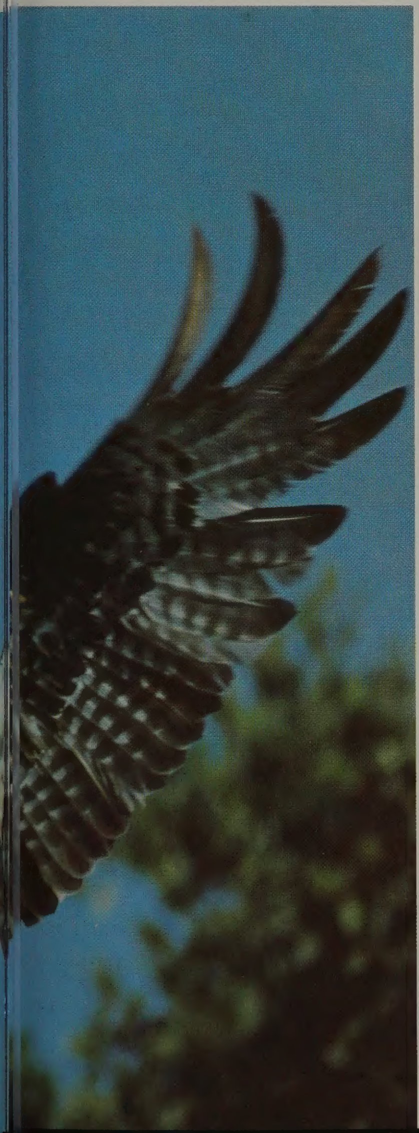
The central beating heart of the Everglades ecosystem is Shark River slough—home of the bulk of the alligator population. But South Florida's present water management system has so altered the natural hydrology of the southern Everglades as to threaten the natural biological processes in this watershed. The success of corrective measures will depend on an understanding of how this ecosystem functioned historically and how current and future management practices could affect ecologically important populations of wildlife.

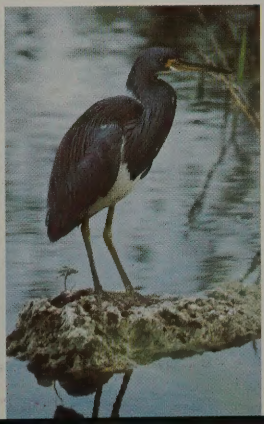
Alligators are the dominant organism of the Everglades. Alligator holes function as a refuge for many of the other park animals, and any sizeable reduction in alligator numbers is bad news—especially for other populations which can make it through the dry season only by "holing up" in the water provided by these thrashing behemoths. It is alligator muscle that pro-

Visitors go bird watching on Florida Bay in a sunrise canoe trip.

Water flow from the Big Cypress National Reserve is essential to the survival of subtropical plant and animal life.

An inspring example of State and Federal cooperation is the saving of Big Cypress National Reserve which provides a fresh water supply crucial to the survival of Everglades National Park. Photos show wood storks in flight, a heron fishing, and the common egret.





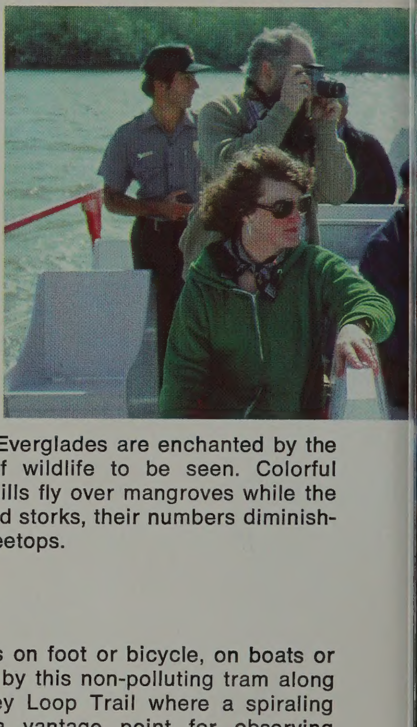
vides the deep depressions into which the waning water seeps and stands, longer than anywhere else, during those breathless, crucial days when to the waiting wildlife it must seem the rains will never come.

Any additional threats, such as unnatural water conditions due to altered quality, disturbed delivery patterns or radical changes in quantity, or the possible reopening of a market for alligator hides, could so profoundly affect this "natural manager" as to change the ecology of the entire park.

Scientists are understandably anxious to develop census and monitoring methods that will indicate immediately any adverse pressures on the overall system. The ongoing natural evolution of the Everglades demands that Shark slough be managed so as to perpetuate alligators in their historic role.

The 1978 alligator work began with a dry season helicopter count of the animals in ponds. Saturation tagging was undertaken in primary study areas. One tool is the "line survey," made by recording the number of alligators per linear mile from a point beginning about 15 miles north of the Tamiami Trail and continuing south to the Gulf of Mexico. Five such line surveys are slated for the 1978 wet season. A typical line, run during the 1977 wet season, found more than 50 alligators per mile in Shark slough.

Like all the other living things in the Everglades, their fortunes ride the tide of



Visitors to the Everglades are enchanted by the wide variety of wildlife to be seen. Colorful roseate spoonbills fly over mangroves while the threatened wood storks, their numbers diminishing, alight in treetops.

Glades travel is on foot or bicycle, on boats or in canoes, and by this non-polluting tram along the Shark Valley Loop Trail where a spiraling tower allows a vantage point for observing wildlife.

Visitors explore mangrove hammocks.

water, suffering equally from drought and periods of too-high water levels. In addition, their high profile at the top of the animal pyramid plus the handsome price on their hides subjected them to hunting pressures that threatened, for a time, their continued existence as a species. Their inclusion on the 1967 list of officially endangered species resulted in such dramatic recovery that the listing was lowered in 1977 to "threatened;" but no such bureaucratic protection is available to buffer them from the fortunes of water. Floods and drought remain the bottom line enemies. So important are water conditions to the populations of alligators in Shark slough that the numbers and condition of the reptiles provide an accurate index to the overall impact of water management practices.

How are we doing with water management? Ask an alligator.

Their complex physical needs are the ultimate gage of whether or not water conditions are generally conductive to health and vitality for all the life forms of the glades.

Alligators build their nests at the beginning of the rainy season (which in South Florida comes in late May and early June). The hatch appears in August. Drastic rises in water levels during that time can flood out the nests; drastic drops can dry them out. The crucial "water-window" between too much and too little is the margin of life for the baby alligators.

Park Technician Alice Rudig operates a conductivity meter, a probe which measures salts dissolved in park waters. With her, recording data, is Herschel Henderly.

Early morning light reveals a great blue heron near the Royal Palm Hammock Visitor Center on the Anhinga Trail.

Visitors take a "swamp tromp" through the sawgrass among dwarf cypress.

As the rainy season ends, the widely dispersed, watery "soup" begins to dry. The 'gator holes become a densely concentrated dish of food for the large wading birds, who nest during the late spring drydown.

Radio collar tags help park scientists keep tabs on the alligators—how they interact, how they use the glades as a home range, how their behavior changes in relation to water and temperature—and this information is filed, stored, and retrievable in a form tailored to computer use.

Whereas alligators are the "top dogs" of the Everglades, the basic, bottom rung on the ladder of life there is periphyton—the name given to communities of up to 200 kinds of algae.

Periphyton communities live attached to the surfaces of other vegetation below the surface of the water and constitute the bottom link in the Everglades food chain. Some of the questions that concern park science include an investigation of the calcium carbonate that covers periphyton in some areas of the park. Why is this coating lacking in other areas? Is water chemistry responsible? Or does the difference depend on the make-up of the bottom soil? What role, if any, does the calcium coating play in the food chain, and what percentage of the total primary productivity (the building of structure from sunpowered photosynthesis) does periphyton provide in the park?

The research so far suggests that periphyton accounts for more biomass than the total produced by all other green plants in the park put together. Since "biomass" means the total bulk of all living things, the showier wood storks and alligators and tropical hammocks that seem to dominate the life of the Everglades take their place more modestly as "the tip of the iceberg." As with all good icebergs, the living mass of the Everglades keeps its periphyton bulk under water.

But Everglades Park isn't all "river of grass." The shallow mirror of Florida Bay is a different cup of water, and anyone who has ever taken the dawn canoe trip from Flamingo out into the Bay will never forget the thrill. Wave after wave of pelicans (both brown and white), herons, egrets, ibis and wood storks congregate on the mud flat vying for food while a lone bald eagle keeps majestic watch from the exact top of a mangrove island about 400 yards away.

On a cool February morning in 1978, a concession guide from the Flamingo pier pointed to a deep pink ibis among the feathered crowd. "That's a hybrid—a cross between the scarlet ibis of South America and its white cousin of the Everglades," he said. Two such hybrids currently were making their home in the park, and the guides had found them easily distinguishable. "We've named them Fred and George," said the canoe trip leader. As all binoculars turned toward the pink target, he added, "That's George."

Small bird life is important too. Bill Robertson, Everglades veteran research biologist, estimated the 1978 flight of swallows that swept through the Park in January and February as "a minimum of 52,000 birds." Attempts to germinate bayberry seeds collected from Park bushes had proved unsuccessful, but seeds collected from swallow droppings during the flight—seeds that had passed through the birds' intestines—showed almost 100 percent germination.

"Obviously," Robertson reflected "there's a neat little symbiosis going on here."

Another precarious link in the delicate tracery of everglades life is the apple snail, common in the freshwater wetlands of Florida, southern Alabama, Georgia, and

Sunrise on Florida Bay as seen from the Flamingo Visitor Center.

An American egret is poised to spear a fish supper while an alligator lurks in the background.

found almost nowhere else. The endangered Everglades Kite is almost completely dependent on this snail for food. Limkin also feed heavily on the snail and it forms an important part of the diet of the boat-tailed grackle and the white ibis. Young alligators and snapping turtles have been known to make an occasional snack out of this snail.

The American crocodile is another of the Everglades' top predators—an endangered species, whose primary habitat is the park's Taylor River Slough. The number of known nests has remained about the same over the past decade, but researchers suspect an overall decline in the population is taking place.

Attempts are underway to determine the status and rate of change of the existing crocodile population in the park, with particular attention to the low hatching success in some nests. Salinity changes and habitat use are under intensive study. Despite the fact that crocodiles are marine animals, the young cannot tolerate high salinity. In much the same manner as so many of the prized ocean fish, crocodiles seem to require a largely fresh water environment during infancy.

The crocodile management strategy is to provide a viable, naturally functioning ecosystem which can serve as the vehicle for preserving a viable crocodile population. Meanwhile, the crocs are hanging on by the skin of their formidable teeth, in ways all of which researchers do not yet understand. In early spring of 1978, high winds over Taylor Slough exposed the mouth of a suspected "den," where it is thought that some of the crocodiles may have dug in to survive the unsually cold winter.

Another kind of resource in the Everglades is the stone crab and it presents a different kind of problem—one of harvest. This relatively new fishery began in the late 1950's and came into its own about 1965. At first pretty well confined to the shallow waters of Florida Bay, crabbing today has extended more than 25 miles out beyond Cape Sable. The numbers of catch show what looks like a healthy increase, but researchers say they actually represent an over-take that is endangering the resource, if not the species.

The practice of pulling off the meaty claws and throwing the crabs back, hopefully to "regrow" another crop, is resulting in the death of more than half the declawed crabs.

Fifteen years ago park waters held between 50 and 60 crab traps. Today, permits have been issued for almost 4000 traps in the park alone, with thousands more in adjacent waters. In spite of harvest restrictions in the park, an 80 per cent decline in catch rate occurred from 1972 to 1977, and for the past three years the catch has been exhausted before open season was two-thirds over.

Sometimes even the tedium of field research can provide a grace note of humor at the monthly science meetings. One technician, who had listened for two hours to reports of alligator tagging, crocodile den-hunting, and other exciting events, finally had his turn.

"Our studies show," he said, "that the flow of water through heavy sawgrass moves at .06 feet per hour. If you want to help, all you have to do is show up and stand in the water four hours while one gallon of dye goes by. It's very restful."

No matter what engaging, bizarre, or fragile form life takes in the Everglades, its fate rides on the water connection. And whether the subject is alligators, fish, herons or periphyton, the bottom line for the Park Service is management.

"We have to learn to *manage* all these intertwined components," Good says, "and research is helping us understand water and the food chain, which together tie the park into one package."

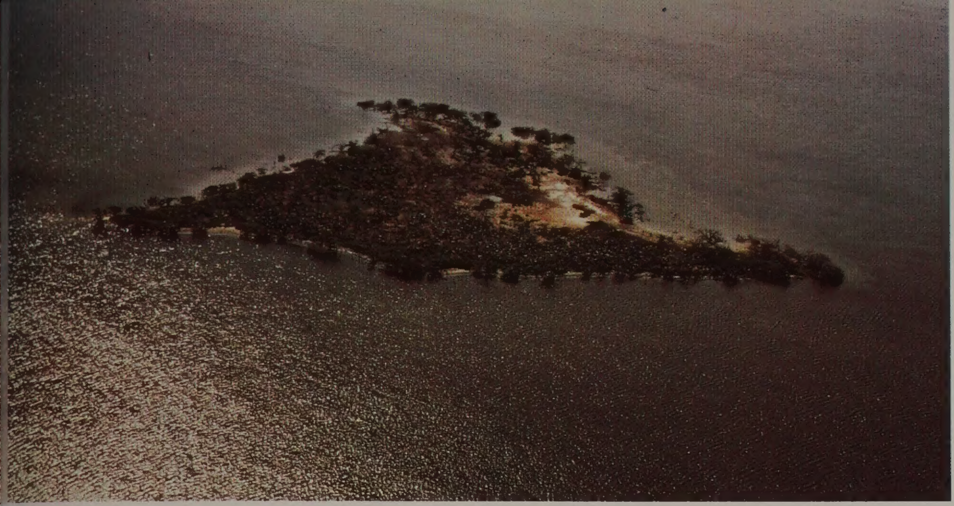
Slowly, painstakingly, out of the masses of detailed information is emerging a handle on the park. NPS Chief Scientist Ted Sudia sums up the research thrust this way:

"It can be disastrous to attempt to manage before you know every vibration your 'twang' on the ecosystem will produce. Rattle the brass in one area and the harmonics may push you over the edge in another. We have to understand the entire orchestration before we can conduct the symphony."

For the Everglades research-management combo, it's tune-up time.

An OLD Bird Takes a NEW Look

By Frank L. Kenney



IT IS THEORETICALLY possible that among the 18 whooping cranes that flew south from their then-unknown nesting grounds to spend the winter of 1937-38 on the Aransas Wildlife Refuge in Texas, there is one that still makes the incredible 2,500-mile annual migration.

If this is true, then this rare but long-lived bird has been linked with the National Wildlife Refuge System for more than half the system's 75-year history.

In 1903, President Theodore Roosevelt started the vast system by setting aside tiny Pelican Island on Florida's east coast as the first national wildlife refuge. He followed this by vigorously transferring other public lands into refuges managed by Interior's Fish and Wildlife Service. Reservoirs behind federally-built dams were made into sanctuaries for migratory birds. The National Bison Range in Montana was established to save the few remaining buffalo. Later, under other administrations, big game refuges were added to preserve remnant herds of elk, deer, bighorn sheep, and pronghorn antelope.

State game departments, during these early decades, were also developing into efficient wildlife agencies. Many States and private conservation organizations made heavy contributions to the preservation of wildlife and its habitat. Theirs was a rear-guard action against a growing national obsession with "progress."

Wildlife, however, continued to decline as habitat was converted to farmland and to urban and industrial uses. Waterfowl suffered in particular as more and more marshlands were drained. Then, more catastrophe. The worst drought in American history struck the Great Plains, hovering over the land through most of the 1930s. Billowing dust storms turned farms into sand dunes. Shrinking wetlands became puddles.

It is to the everlasting credit of the people of those Great Depression days that they took time from their own problems to consider what the disaster was doing to America's native wildlife. Their response is one of the brightest chapters in the history of wildlife conservation. Congress voted the Migratory Bird Hunting Stamp Act into law in 1934 to raise funds to buy marshlands for refuges. The Civilian Conservation Corps and the Works Progress Administration threw hundreds of men into the effort to save habitat.

So it was, when that whooping crane began his trip southward that fall of 1937, he found refuges along the flyway for all migratory bird species. When he arrived at Medicine Lake National Wildlife Refuge in the northeastern corner of Montana, he saw work crews digging ditches and building dikes that would restore alkali flats to lush marshlands.

As he moved down across the Great Plains, he found similar work in progress at Lacreek Refuge in the southern part of South Dakota; at Crescent Lake Refuge in Nebraska; at the Salt Plains Refuge in Oklahoma, and most important of all, at Aransas down on the Texas Gulf Coast.

There, he and the other cranes would, for the first time, spend winter in the complete protection of a wildlife refuge. But even more important, the habitat would now be preserved. And in April, when he flew north using many of the same refuges and resting places as he'd discovered the previous fall, he'd find his nesting grounds safe, too, deep in the wilds of Canada's Northwest Territories. It would be 16 years before forest firefighters, scouting a blaze in Wood Buffalo Park near the Great Slave Lake, would locate the small nesting colony of whooping cranes, so long an ornithological mystery.

He saw other refuges added to his narrow corridor of travel during those 40 years, Lostwood, Audubon, Lamesteer, Pocasse, Kirwin, Quivirs, and more, each one providing the bit of wilderness so essential to his own survival and that of every wild animal. He saw ducks and geese and many other migratory birds return by the hundreds of thousands, and he saw his own number increase gradually so that this fall, if he returns, he'll be one of more than 70.

But he saw only a slim cross section of the refuge system as it exists today. He didn't know that elsewhere other refuges were functioning in the same ways for migratory birds, and providing habitat for all kinds of resident wild animals as well. He never understood that what he'd seen was only a small part of a massive program that gave America the greatest refuge system on earth—nearly 400 refuges with a total acreage of about 34 million.

He cared only that he could find his place of wintering and his place of nesting, and that there always would be a few places inbetween where he and his progeny can stop to rest and to feed.

Mississippi sandhill cranes

Original watercolor by Bob Hines

OUR ENDANGERED HABITAT

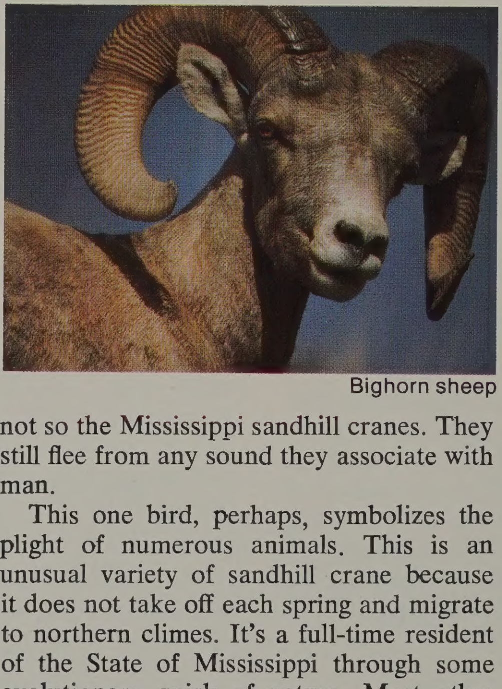
UNSPOILED LAND is what we usually mean when we say endangered habitat. It's that piece of real estate with tender fragile blossoms, vines, green life, and a natural untouched beauty standing silent in the morning fog through which a Mississippi sandhill crane carefully treads on its misty dawn walk for food.

The rustle of a leaf catches the crane's attention and it goes rigid. A shift in the breeze brings it to attention to scan the horizon. It returns to feeding, alert but familiar with the natural enemies it faces, skittish but reasonably secure in its wild, free living space.

An alligator would make a quick meal of this long-legged bird, but the crane knows this by instinct and usually avoids areas where the gator lurks. Still, it happens every now and then that a crane too preoccupied with its own sustenance becomes an alligator's dinner. That is nature's way of ensuring the survival of the fittest.

Over thousands of years birds like the crane have evolved an instinct to survive in their own virgin lands. A silent alarm system not yet fully understood by science alerts them to danger. The sound of a gun stirs this bird to panic and a desire to escape as fast as possible. The backfire of a truck or the staccato roar of a motorcycle sends it flapping into the air, squawking with indignation.

Cranes and many other animals have not been able to adapt to the fast-paced world of man. Why, 50 years ago there wasn't a single car in this part of Jackson County. If one showed up, it was as much a curiosity and a fright to the humans in the area as it was for the cranes. By now, however, the human residents of Jackson County have formed their own love affairs with automobiles and pickup trucks. But not so the Mississippi sandhill cranes. They still flee from any sound they associate with man.



Bighorn sheep

This one bird, perhaps, symbolizes the plight of numerous animals. This is an unusual variety of sandhill crane because it does not take off each spring and migrate to northern climes. It's a full-time resident of the State of Mississippi through some evolutionary quirk of nature. Most other cranes in the world migrate over great distances twice each year. This one doesn't, and it must pay a very steep price in terms of survival. It is threatened even more by the fact that its virgin living space is being fast encroached upon by man. Today it is listed as an endangered species.

The bird is now found only in limited numbers in swampy marshland that measures about 26,000 acres in Jackson County.

Inexorably it has been quietly pushed and shoved back into this swampy land over the past 50 years by the construction of suburbs, beach resorts, and concrete highways which now crisscross the State. Overhead electrical lines, too, present an additional hazard to flying birds of this great size.

Today the bird, fortunately, has a defender in the Endangered Species Act. This law enables the Interior Department to mark off land areas considered critical for the survival of a creature faced with extinction.

The Mississippi sandhill crane faced an uncertain future when the construction of a Federally funded highway interchange was scheduled to cut right through its swampy tract. Science and the law came to the rescue, however, and documented the fact that within this area there were seven nesting sites of this endangered bird. Unbeknown to the construction engineers, this concrete pathway would have knifed through the very nursery of the unique cranes, a move which could have pushed the bird over the brink of extinction.

The story has a happy ending because a critical habitat determination was made in time and all parties are now working on a compromise solution to enable the birds to survive and the highway to be built around their endangered habitat.

The major thrust today of all Federal wildlife conservation efforts is toward saving living space for animals. Open, unspoiled land is disappearing rapidly. The disappearance of the animals is simply a

Canada goose nest, Alaska

symptom of this more basic illness of our modern world.

The research muscle of the U.S. Fish and Wildlife Service and all the major programs of the organization devote a considerable portion of manpower and resources to preserving living space for animals. Intense studies of seemingly open lands are conducted across the country to monitor the presence of pesticides and pollution from all sources. Construction projects of dams and bridges on rivers and streams need investigation to ensure that the needs of wildlife are taken into account at the planning stage. The search for new sources of energy has stirred new interest recently in making sure the baby doesn't get thrown out with the bathwater in this rush for fuel. Numerous studies have been done in the past two years to establish a baseline on the condition of the living spaces about to be invaded by coal and oil exploration. Coastal swamps and wetlands are also the subject of special intense study as development in all of these choice vacation areas threatens numerous animal forms.

Congress endorsed the idea of critical habitat when it passed the 1973 version of the Endangered Species Act. It wanted to provide some measure of protection to those animals but at the same time allow progress for man. It wanted to ensure that man did not overlook the needs of endangered animals in his own expansion of roads and other human developments.

Water control work at wildlife refuge

The concept at present does not allow the dropping of an iron curtain around a piece of real estate. It simply requires that Federal agencies of government make sure the programs they fund or authorize do not impinge on the existence of these animals. It does not give the Federal Government any land rights such as easement on private lands at all.

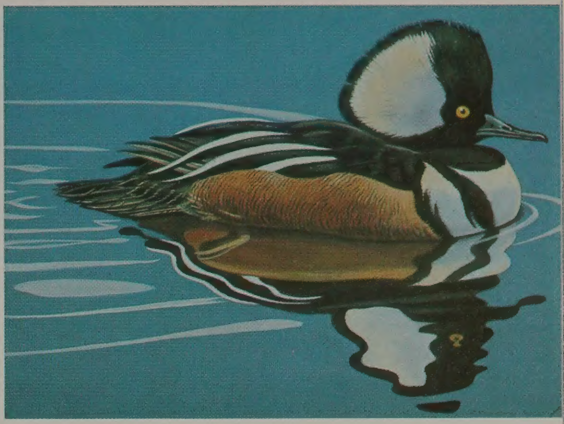
The term is defined as the area of land, water, and airspace required for the normal needs and survival of an animal. This includes space for growth, movement, and behavior. It also includes sites for breeding and raising offspring and space needed for cover and shelter.

The concept is simply a tool for wildlife managers to save and restore species that are endangered. It is not a weapon to hinder economic or social progress. It is a way to help other Federal agencies such as the Defense Department for example, make sure that actions such as field maneuvers for a tank battalion in the California desert do not invade the living space of endangered animals.

While the enumeration of America's endangered species proceeds, science is turning its attention toward studying the actual living space requirements for all 170 native endangered animals. This is a laborious process but in the last few years 12 such areas have been studied and delineated. Seven of these have been approved and the others await the debate and approval of the public.

Snow geese, California

Common egrets, Florida



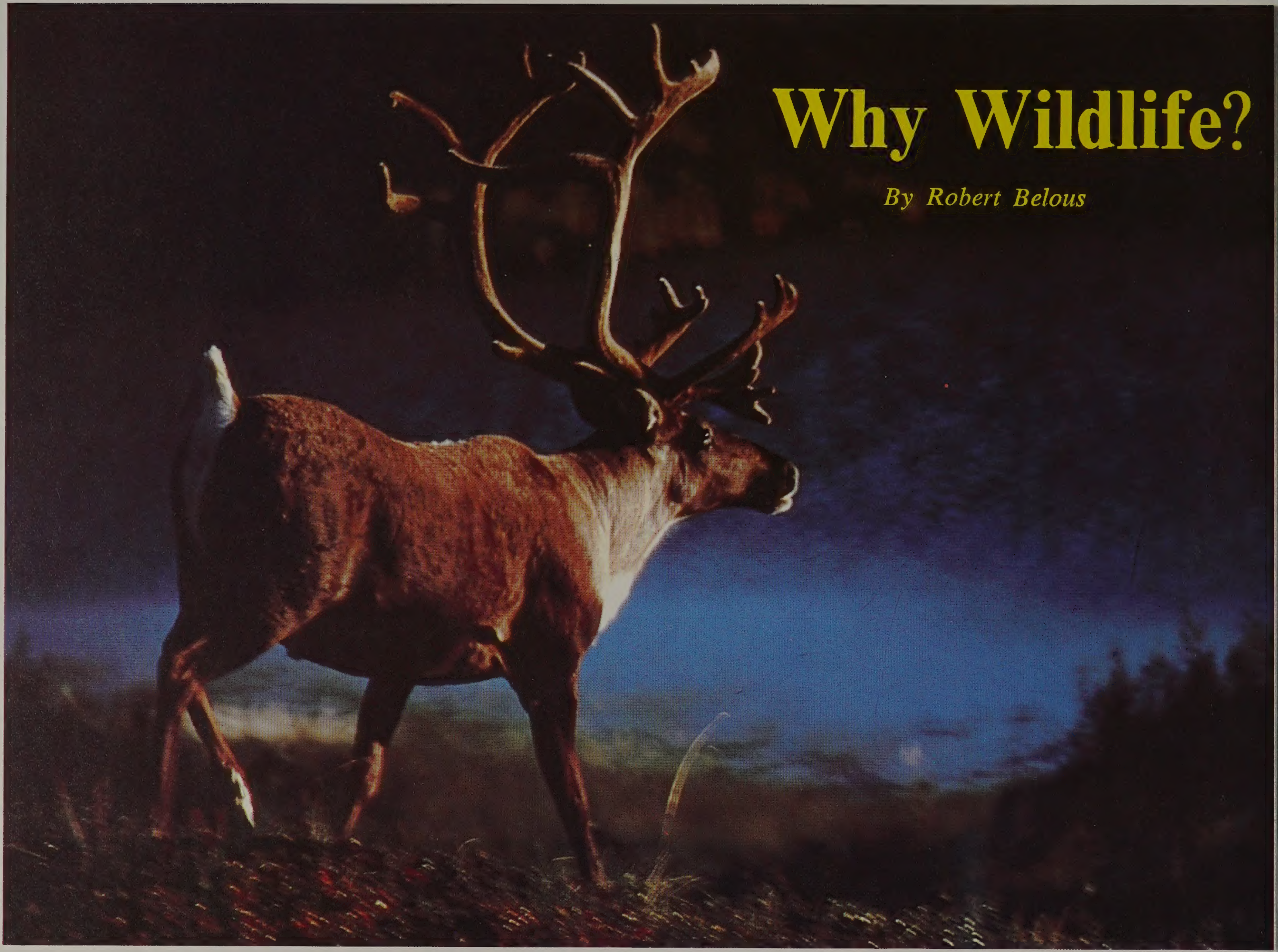
A dramatic watercolor of a hooded merganser drake in full mating plumage won the 1978-79 Duck Stamp competition for self-taught Connecticut artist Albert Earl Gilbert. Revenues from the $5 Migratory Bird Hunting and Conservation stamps help to purchase wetland habitat for wildfowl. Since 1934 over $200 million from stamps sales has been devoted to acquisition for the Fish and Wildlife Service of some 2.1 million acres of prime habitat. Competition is intense at the annual art competition, as the winner's wildlife art is avidly sought by collectors.

As the public has come to understand the philosophy behind the idea, it has begun to applaud this philosophy. The preservation of critical habitat is now emerging as central to the preservation of the species themselves. It is a single pure idea devoted to preserving a part of nature so that a peaceful equilibrium with man and his needs can be maintained. This new conservation philosophy underscores the basic web of life woven tightly by natural law around and among and between man and the animal world. It recognizes that man's knowledge of his own needs in the future is slim at best, and it is a tribute to the humility of science that leaves the unknown questions open and gives as much benefit of the doubt to the animals as reality permits.

In the final analysis any law with an idea as radical as the concept of critical habitat will only perform as intended if it has the backing and support of the citizens of the country. Many land owners are finding that it is one thing to support the habitat concept in the abstract, but have second thoughts when their own economic interests are at stake. The question, then, becomes one of the greater good of the majority, the basis of general law in this country. Fortunately, most citizens have shown themselves to be able to live with principles and practicalities of ideas such as the one of critical habitat. After full public hearings and wide discussion of the details of each of the proposals the majority of Americans have supported the implementation of this idea in their own home communities.

As time goes on and public understanding of these critical habitat areas becomes more clear, more and more land owners have come to realize that habitat retention is a necessary step forward in our democratic way of life—to move over just a bit and make room for the needs of wildlife.

Most reasonable people quickly identify the basic issue in these complicated biological subjects because the overall health and condition of our animal world is but a reflection of the overall health and condition of man's world. For if the waters which are polluted kill off the fish which are endangered, how much longer may man use the same water safely? That is what critical habitat is about. It is about still clean land and waters serving as the barometer of man's overall social, economic, and environmental health.—*Gerald Waindel and Patrick McGarvey, from Fish and Wildlife Service sources.*



Why Wildlife?

By Robert Belous

WILD CREATURES mean different things to different people. To a city-dweller, the sight of a coyote trotting across a backcountry road could be the highlight of a summer trip. To a sheep rancher the same prowling predator may conjure less delightful images. Yet there seems to be a trend. Along with the decline and threats of extinction for some of our birds and animals during recent decades, a kind of redirection, maybe even reverence, has come to pervade our thinking.

Snowy egrets no longer die by the thousands for the sake of stylish hats. Alligator shoes have become uncomfortable, if not embarrassing. Celebrities have been roundly chided in public for wearing garments made of tiger skin. And wide-spread concern for the unpredictable ways of Alaskan caribou herds has kept oil companies and biologists busy since the strike at Prudhoe Bay in 1968. "We want and need wildlife," it all seems to say.

But why?

One reason is that wild creatures of all kinds have come to offer some reprieve from a plasticized world of aimless affluence and predictable horizons. A glimpse of a free-roaming critter somehow brings thoughts of an unsullied landscape that inspired and sustained earlier Americans. Through wildlife we look again for such a world.

A marten or lynx suggests to us that a portion of the earth is still wholesome, intact and untrammeled, that streams are drinkable and the delicate food chain undisturbed. Sadly, this is sometimes in error. A fine-looking tuna may carry traces of deadly mercury; and radioactive isotopes of cesium and strontium may lurk in the bone marrow of a prime arctic caribou.

Nevertheless, modern man derives balm from the presence of wildlife. A well-furred mountain goat or trophy Dall sheep ram tells us that all is well, the world is not dying, the doomsayers are wrong. Animals are a barometer of well-being, and an area that has them in any abundance or diversity must be in pretty good shape. Like the canary once carried by miners to test the air deep underground, wild creatures are a measure of our own survival.

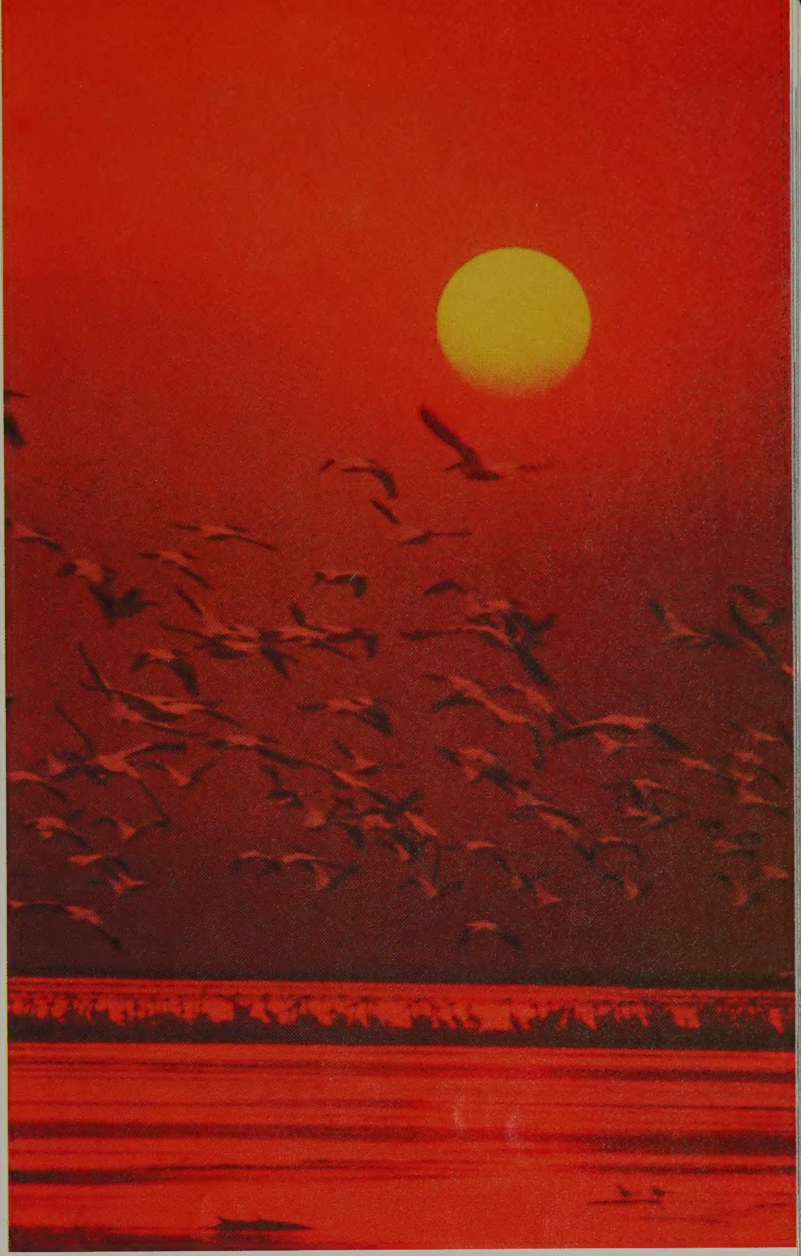
Another reason is that an encounter between man and wild animal is a first-hand experience, undiluted, irreducible, real. It is not an ad or enticement to buy the latest gadget or new car. It is an unplanned and refreshing change from the second-hand experiences of movies and the synthetic adventures of television, no matter how wild the kingdom portrayed. The media, you should recall, tell us of the interesting things *others* are doing. Coming upon a wild creature lets it happen to us.

Let a giant bull moose step from evening shadows along an Alaskan highway and there ensues a traffic jam of tourists and well-travelled truckers, all joined in a fit of craning necks and scrambling for cameras. Zany antics of the river otter can bring to the most troubled face a light and marvel beyond the reach of nostrums and remedies of medical science.

At Stony Hill, Mt. McKinley National Park's famed vantage for viewing our continent's highest mountain, a lone dark wolf ambling along a nearby hillside held in awed silence a large group of foreign and American visitors—their backs turned on the magnificent summit they had travelled far to see.

In short, an encounter with a wild creature is an unmatched source of spontaneity, peeling away the cloak of indifference that we learn to wear from day to day. Even if the result is a momentary surge of dark terror, as when meeting a bear on a narrow trail, the blood, the muscles, the brain, all remind us that we are indeed alive.

But surely a central reason must be that it brings us a step closer to the earth and to a world that we too often ignore. More



Left, Caribou at Mt. McKinley, Alaska. Above, greater snow geese at Assateague Island, Maryland. Below, a Fish and Wildlife biologist examines an immobilized Kodiak Island brown bear. Right, white pelicans rise against the setting sun.

than 12 million waterfowl find their way into Alaska's crisp autumn air without regard to recent trends in the Dow Jones averages. Waves of salmon returning from the trackless ocean taste their way back to the stream of their birth, there to renew their kind—all this despite the bevy of global crises that make up our daily concerns. They respond, instead, to a deeper call in acting out their ways. And so do we through the encounter. Moreover, it leaves us strangely puzzled as to just how immune we are to similar imperatives, or just what we may suffer by denying them. Lessons are being offered, it seems, and we are beginning to listen.

The trend touches folks of all ages and persuasions. A savvy high school student fell to lecturing his parents during a park visit about the puckish creature that startled them from a spruce tree. It was a marten and not "some kind of rodent." He went on to tell how this fetching member of the weasel family survived the ages of Pleistocene glaciers by lengthening its gestation period from a scant 27 days to 240 days in order to span the long and hostile winter. There were many pre-Pleistocene species that never made it over the hurdle of ice. The marten did. Let's get to know our fellow survivors.

Deep in Alaska's Brooks Range, I have sat around a campfire with a party of hunters discussing the arctic's barren-ground caribou. Unlike past experiences where the subject was limited to comparing cartridge weights and loads for the best kill, the subject turned instead to the caribou's many strange adaptations for life at the top of the world. Their restless, tide-like migrations—one of the awesome spectacles of the far north—is controlled by such subtle signals as lengthening daylight and the changing texture of snow. With uncanny precision, these forces waft the herds northward to spring calving grounds for that brief period of optimum conditions for survival, when wolves are denning for birth of young and the arctic's horde of blood-sucking insects have not yet hatched from the wet tundra.

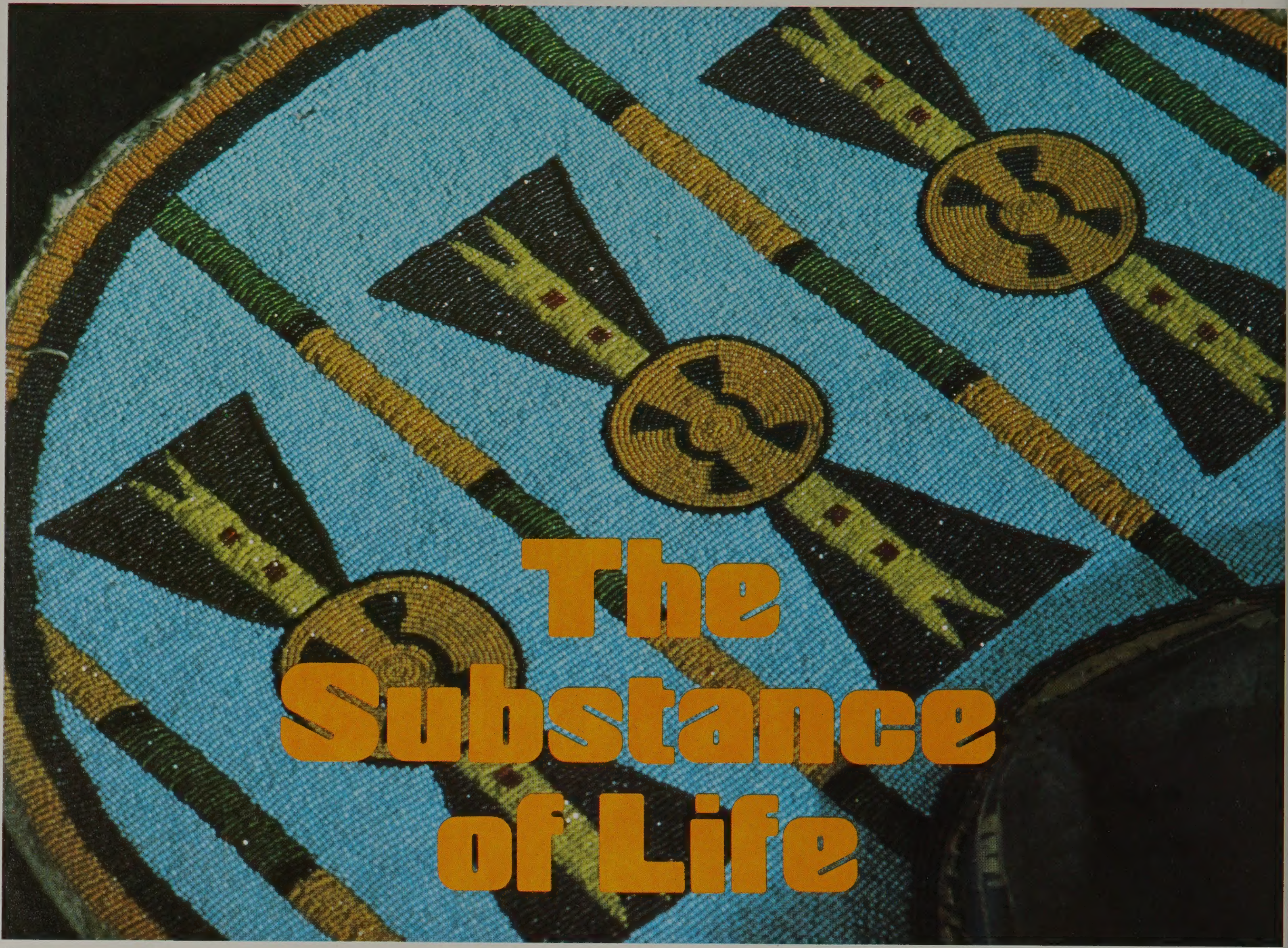
We marveled, too, at the unusual gland located between the caribou's rear hoofs which leaves a small scent patch on the ground when the animal bolts from fright. The odor, though indiscernible by man, can turn a whole migrating herd away from the spot.

Changing views toward wildlife have even come to affect the role of the management biologist, often accused of seeing animals as a resource with only two variations: UNDER-harvested and OVER-harvested (both of which require their supervision). But the esthetic quality of wildlife under completely natural conditions of habitat and cyclic change has become a goal to be reckoned with. In the words of one Alaskan biologist: "Game management is really people management, when, where, and how much harvest to allow, and just how much habitat to sacrifice." With human impacts under control, fish and game usually do pretty well on their own.

Whether we seek them for food or trophy, or just to take home as fond memories in one's camera, it has become plain that wildlife are indeed an important part of the American heritage. We share our nation with many colorful and unique neighbors and no longer casually accept their loss or abuse. They afford us a very special access to our own character, a chance to learn something of ourselves that we are perhaps too guarded to discover in other ways.

Having read these words in search of "Why Wildlife?", you have briefly joined with caribou on their ages-old round, and even peeked into a marten's maternity den, and maybe made a small discovery about your own interests. If the trip was worth it, the question has been answered.

The Substance of Life



The geometric pattern of the Nez Perce Indian cradle board reflects Indian acceptance and use of the designs and ways of nature.

NEWSPAPER ARTICLES OR TV REPORTS on Indian affairs are commonly about conflicts or issues—protests, land claims, court rulings and the like. The news, by its nature, deals with the unusual; the everyday events that are the substance of life are seldom reported. These pages tell briefly of some of the substantial, day-to-day things that are happening within Indian country in tribal programs assisted and supported by the Bureau of Indian Affairs.

By Vincent Lovett

THE NAVAJO INDIAN Irrigation Project in northwest New Mexico is now the largest irrigation project in the world. A tribal enterprise, Navajo Agricultural Products Industry, is growing vegetables, alfalfa and other good things on the first 30,000 acres of formerly arid and semi-arid land to be put into production.

Eventually, the project will include 110,00 acres, will provide jobs for more than 6,000 persons and generate total annual revenues in excess of $150 million.

Though the huge irrigation project is extraordinary, it is illustrative of a healthy spirit of development that can be found on Indian lands throughout the United States.

The Indians and Alaskan Natives are joining their traditional respect for the land and nature to modern concepts of technology to bring about economic development that accords with their cultures and heritage.

In the Northwest where fishing is a major industry, the tribes have formed two coalitions—the Columbia River Intertribal Fisheries Commission and the Northwest Indian Fisheries Commission—to maintain and enhance the fisheries they use. Hatcheries, operated by Indian tribes, on lakes and streams in the Northwest and in other parts of the country, are designed to assure the next generation a good catch.

The sport fishing, hunting and other natural attractions preserved on Indian reservations have enabled the tribes to make tourism a major source of employment and revenue.

On the Mescalero Apache Reservation in south central New Mexico, for example, the visitor at the tribe's luxury Inn of The Mountain Gods can enjoy unequaled deer, elk or bear hunting, ski the 12,000-foot Sierra Blanca mountain, fish the mountain lakes, play golf or tennis or just enjoy the scenery.

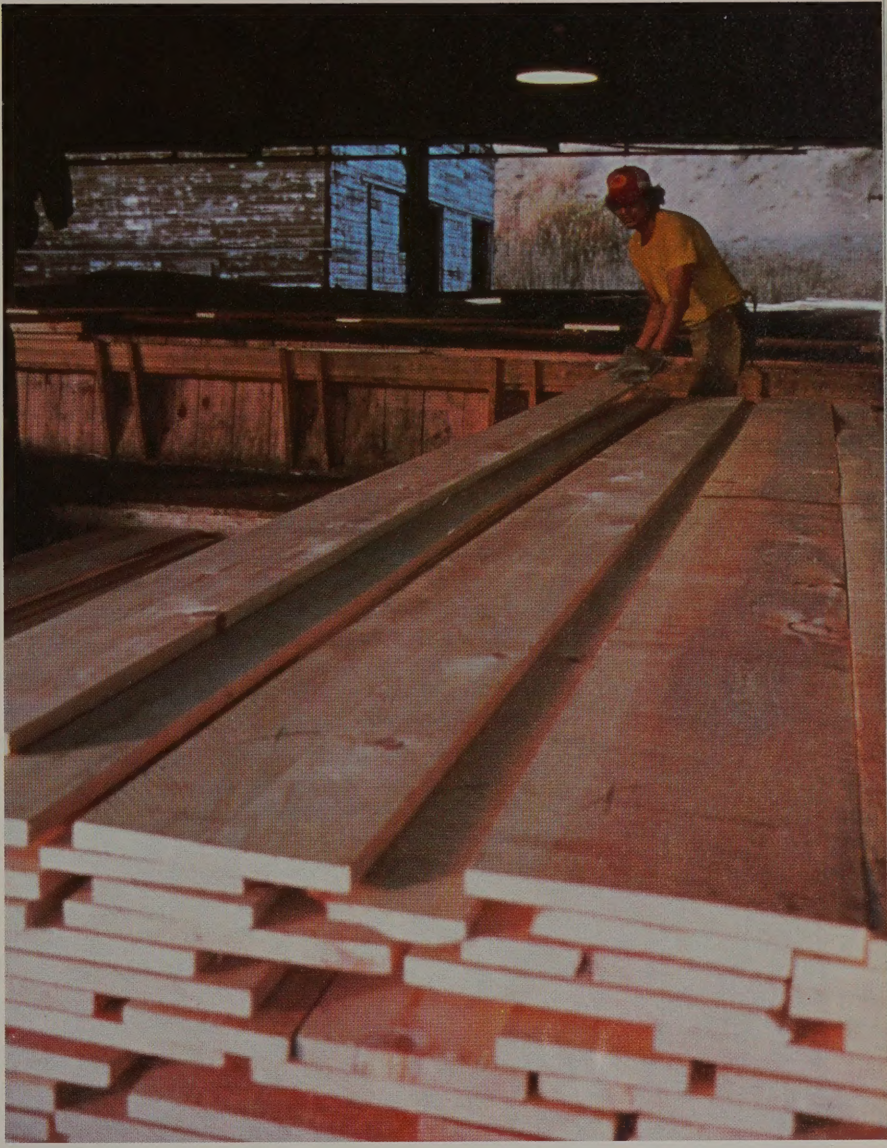
More than 100 tribes are members of the American Indian Travel Commission as operators of hotels, motels, campgrounds, parks and recreation centers.

Livestock breeding and feeding is a principal occupation for Indian people — from the small family herd of sheep to the large tribal cattle business. Baling hay for winter feed (above) and mixing corn with alfalfa for feeding lambs (below) is an integral part of this work.

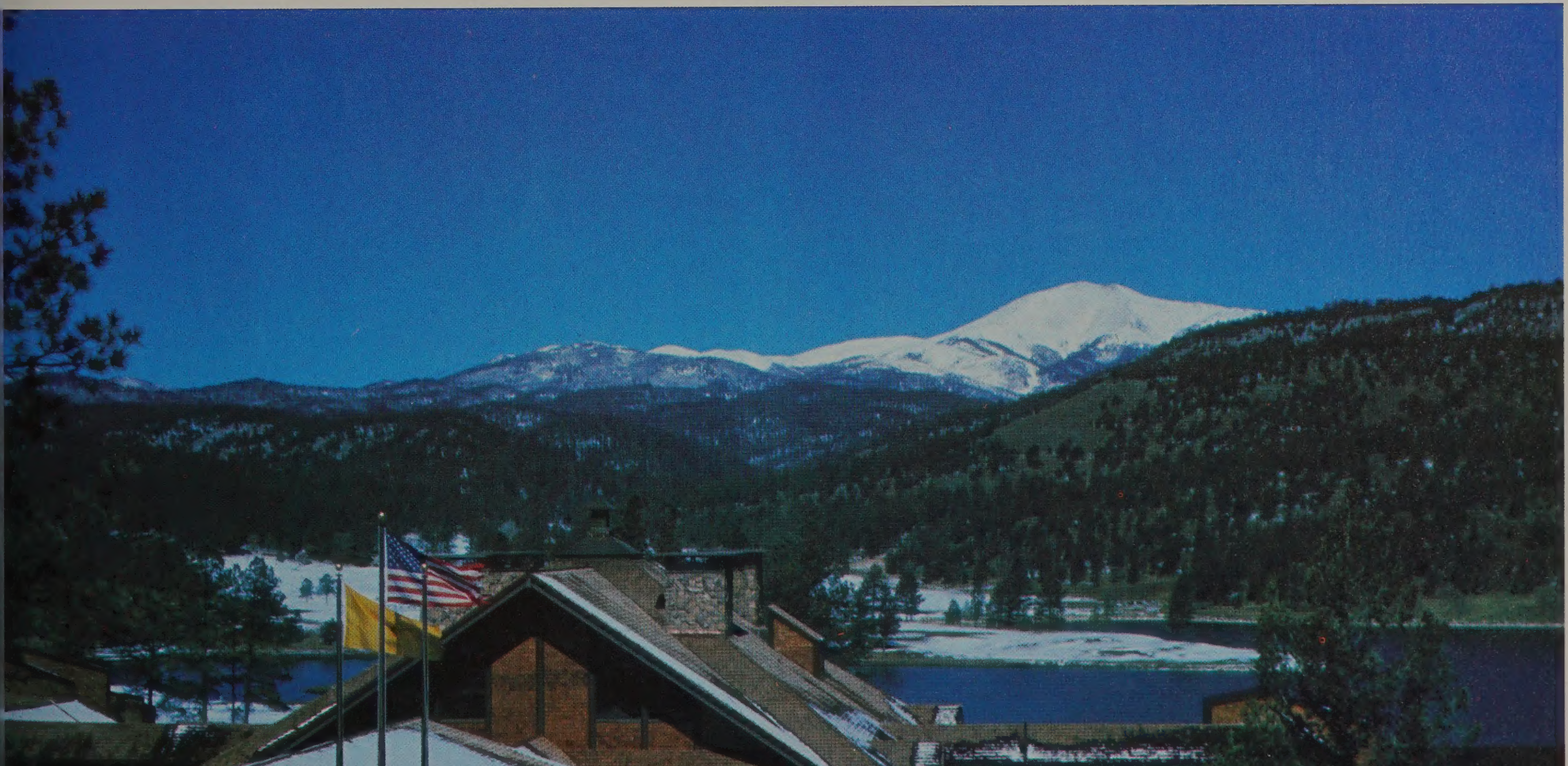
Forestry is one of the most common tribal industries. About two-thirds of all American Indian tribes are involved, cutting an annual total of almost one billion board feet. Modern techniques of sustained yield management are used.

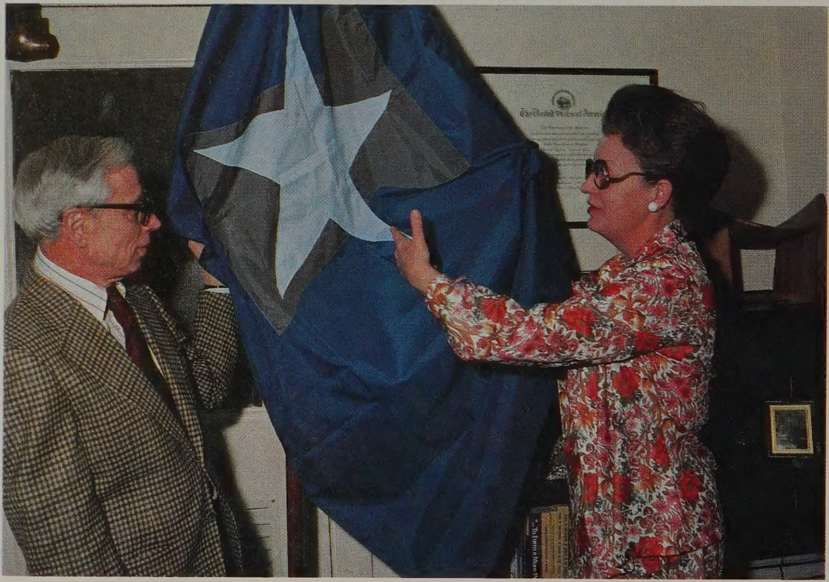
Cowboys and Indians in the movies are separate groups of people. In real life in the western United States, many of the Indians are cowboys. Almost all the tribes are involved to some extent in the livestock industry, using a total of approximately 40 million acres for grazing purposes.

Our American frontier today is Alaska. The Alaska Native Claims Settlement Act being implemented now gives Alaska Native regional and village corporations some 40 million acres. The control and use of this land by the Natives gives them an economic base and it also gives them the opportunity to maintain and preserve what they value of their culture and ancient ways.



Aspects of the Indian Timber industry are shown above. Below, is the Indian-owned Inn of the Mountain Gods with the white-capped Sierra Blanca in the background. At far left is a rack for drying fish for Native subsistence in Alaska and (Lower center) a Lummi Indian in the Northwest is draining and cleaning fish in the Tribal hatchery.





UNDER SECRETARY James A. Joseph, second from right on dais, represented the Department of the Interior at ceremonies on Saipan marking self-government of the Northern Marianas. (Second from top) John DeYoung and Ruth G. Van Cleve display the new flag of the Northern Marianas in the Office of Territorial Affairs. (Third photo) American Samoans await ceremonial dancing on Flag Day. (Bottom) United States Marines display the American flag at the Liberation Day parade in the Marianas. While Saipan girls perform their traditional sword dance (above), more impromptu dancing enlivens Flag Day on Samoa.

Territories in Transition

THE FIRST NINE days of 1978 saw the inauguration of popularly elected chief executives for the first time in the histories of American Samoa and the Northern Mariana Islands.

At Pago Pago on January 3, Peter Tali Coleman took his oath s American Samoa's first elected Governor in the presence of nder Secretary of the Interior James A. Joseph, President Carer's official representative, and Ruth G. Van Cleve, Director of nterior's Office of Territorial Affairs. Governor Coleman has erved the U.S. Government for 25 years as American Samoa's ttorney General and as Acting High Commissioner of the Trust erritory of the Pacific Islands. He has the distinction of having erved 20 years earlier as the first Samoan to have been an ppointed Governor. Sworn in with him as Lieutenant Governor vas Tufele Li'a, a ranking High Chief, who was Commissioner for ublic Safety in American Samoa prior to his election.

In the Western Pacific, another dramatic sequence in the selfovernment of the Northern Mariana Islands (located between uam and Japan) was set in motion with the inauguration of arlos S. Camacho, public health physician, as Governor. Franisco Ada, for many years Administrator of the Mariana Islands istrict, was sworn in as Lieutenant Governor.

With this ceremony on January 9 began the first phase of the Northern Marianas becoming a Commonwealth of the United States. The 15,000 Chamorros of the 16 Mariana Islands have long petitioned for closer ties with the United States. Since 1947 these islands have been part of the Trust Territory of the Pacific Islands which has been administered by the United States under United Nations Trusteeship. Their 184 square miles comprise the first new territory to be added to the United States since 1917. It was on Saipan, the largest island of the archipelago, that U.S. forces waged one of the bloodiest campaigns of World War II, culminating in 3,114 American and 30,000 Japanese casualties in six weeks of battle in 1944.

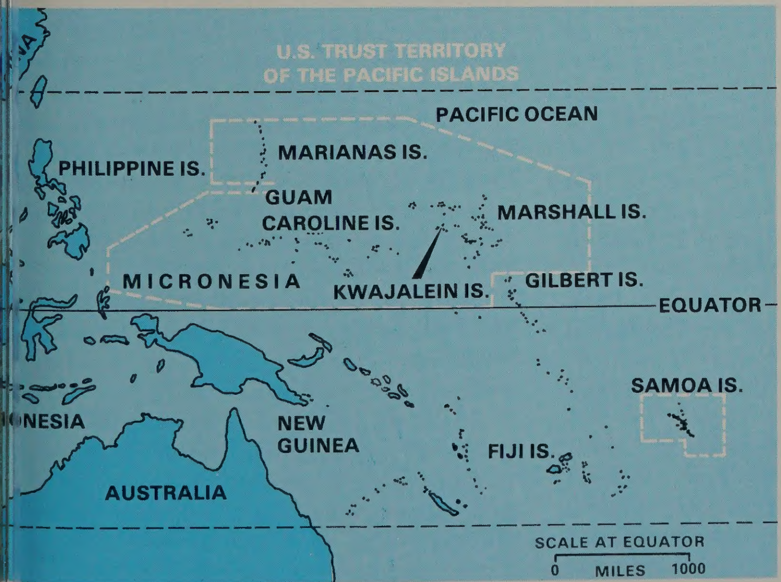
This January, U.S. Marines fired a 17-gun salute as the Commonwealth flag was raised beside the Stars and Stripes, and Bishop Flexiberto Flores celebrated High Mass in the Chamorro language, a mixture of the old island tongue, English, Japanese, Spanish and German—reminders of earlier occupations of this extraordinarily beautiful island group.

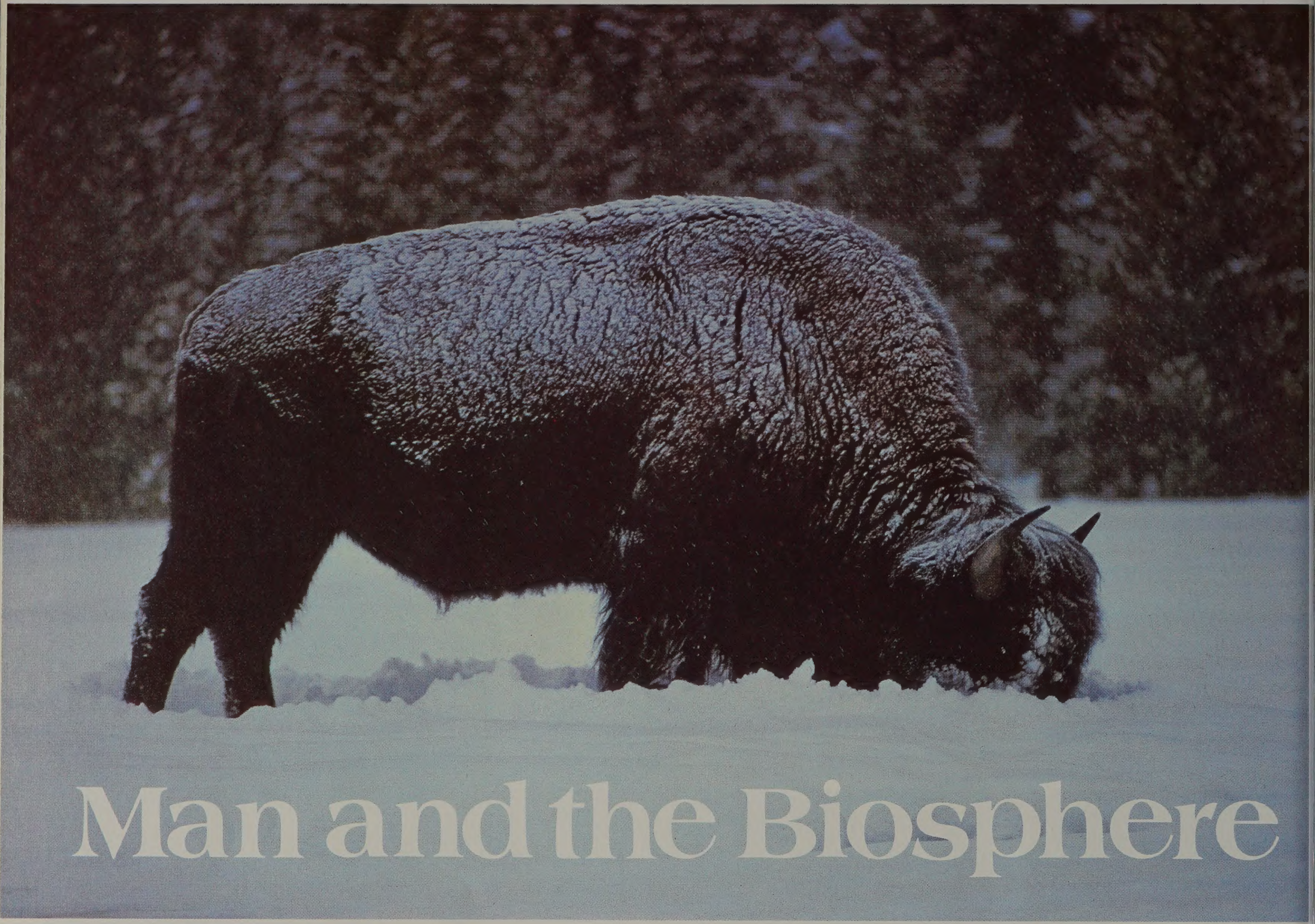
In his televised greeting to the new Americans, beamed by satellite, President Carter said: "Although I shall be on the other side of the world during this auspicious occasion, my thoughts and blessings will be with the people of the newest member of the American family."

Standing smartly offshore was a U.S. Coast Guard cutter now stationed in the Marianas to enforce the 200-mile international fishing limit.

With the inauguration of Governor Camacho, the Northern Mariana Islands Government will become an internally self-governing unit some 6,000 miles from our shores, although it will remain under U.N. Trusteeship until that arrangement is ended for the entire Trust Territory. President Carter has set a target date of 1981 for terminating the Trusteeship while the final political relationship for the rest of Micronesia is worked out.

FACES OF THE Marianas people reflect both their beauty and their dignity. From left are Jesus Oman, Darlene Macarana, flower-bedecked Dolores Seman, and little Bobbie Ann Conception, all of Saipan. Perhaps the rainbow is an omen in this view of the Island of Saipan from the Tinian Channel.





Man and the Biosphere

The world's first national park, Yellowstone, includes 2.2 million acres of geysers, lakes, mountains and waterfalls in Wyoming, Montana and Idaho

> **"Biosphere: That portion of the earth's crust and lower atmosphere which supports life."**

By Robert McCallum and Paige Grant

Within the last decade alone, man's impact upon the global environment has become heavier and more damaging.

As demand for goods and services takes quantum jumps with population, so does pollution of air and water and the rate of depletion of natural resources. People once could dig and fill anywhere they wanted, clear forests for wood, abandon their depleted soils, foul the waters—do whatever they needed for gain or survival because the earth seemed to possess an infinite capacity to absorb these abuses and renew itself. Vast reaches of yet-to-be-exploited land allowed man to move on when he had used all available resources where he had been.

It was easy to see the economic benefits of dredging a river for navigation, damming a stream for irrigation, draining wetlands to provide more farmland. What was not so obvious was the great toll that these actions were taking of wildlife and their habitats, of water quality, in fact of all components of the environment. Although a few individuals of exceptional vision warned of the detrimental effects of some of man's activities, it was not until recent times that a general awareness has developed that we must treat earth with more care. We find that we are running out of frontier lands.

The environmental problems of the earth can no longer be the responsibility of only a few nations. All nations have to be aware and ready to take any action that might be necessary to address these issues. To improve the environmental health of the planet will require a commitment parallel to that which rocketed man into space in the 60s.

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) undertook such an effort in 1970 when it launched the Man and the Biosphere (MAB) Program. UNESCO set out to cut across national boundaries, and mobilize an international network for conservation of genetic diversity, environmental research, and education in natural resource management. Participating today are 87 nations.

MAB works together with other international conservation and resource management organizations, such as the United Nations Environment Program (UNEP) and the International Union for the Conservation of Nature and Natural Resources (IUCN). MAB is management oriented and wholly intergovernmental. It is determined to reduce the barriers that exist between natural and social scientists, land managers, businessmen, and government leaders, and to unite their efforts toward improving the relationship of man and the natural world.

Addressing these broad goals are 14 MAB projects, each developed by an international panel of scientists and government administrators.

Some projects focus on broad categories of ecosystems, those of forests, tropical and temperate; grazing lands; arid zones, fresh and coastal waters; islands; and mountains and tundra. Others focus on systems and processes;

Now an internationally recognized Biosphere Reserve, Yellowstone is the habitat of great numbers of free-roaming wild animals. Left, a buffalo forages for grasses, and right, a bull elk rests during a snowstorm.

pesticides and fertilizer usage; engineering works; urban ecosystems; demographic change; and perception of environmental quality and pollution.

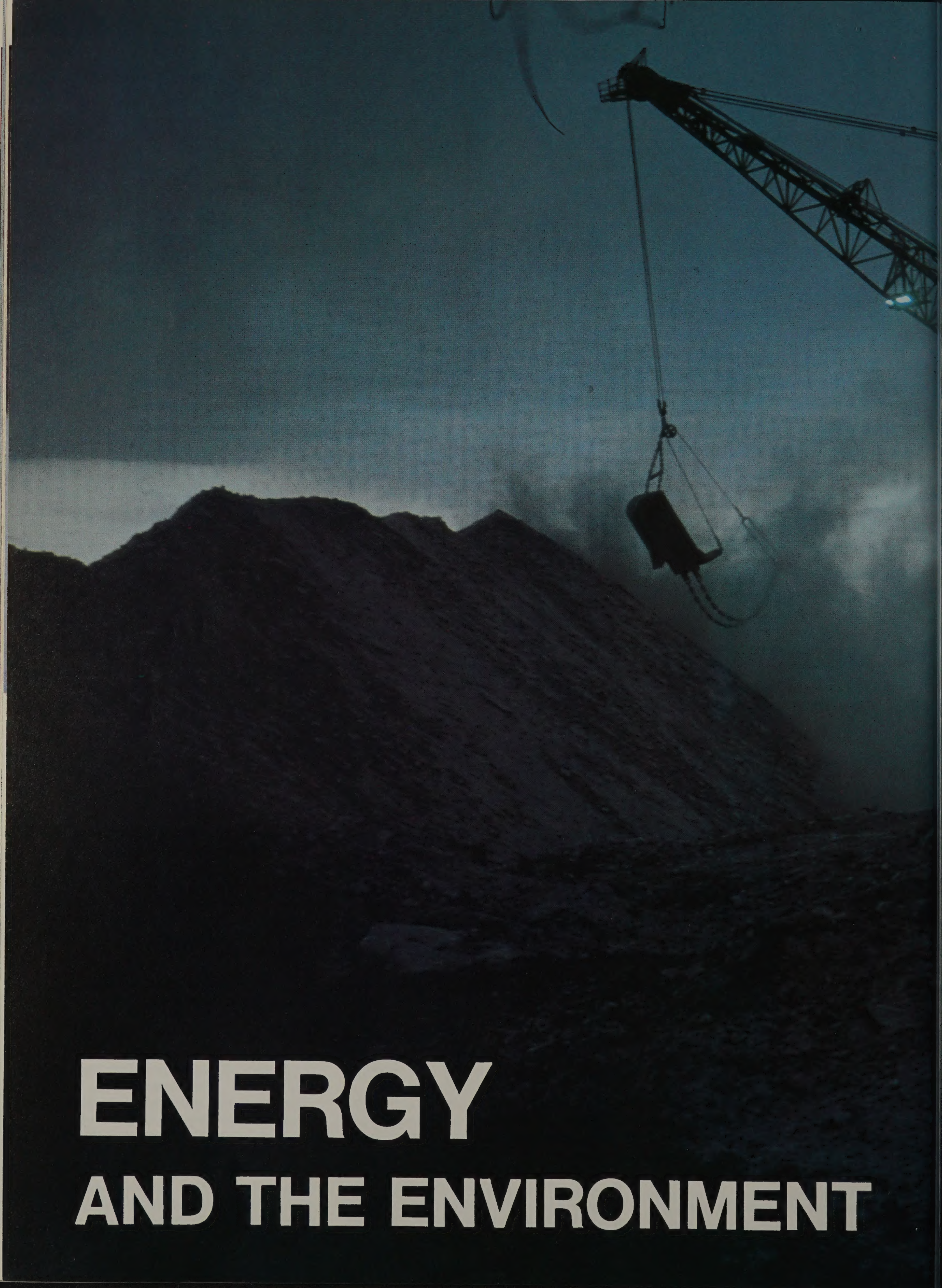
Of the many projects, the Department of the Interior is most involved with Project Eight which concerns the development of an international network of "Biosphere Reserves," and their use for research, monitoring, conservation, and education. A goal of Project Eight is to comprehend the functioning of our biosphere—that portion of the earth's crust and lower atmosphere which supports life—and to learn how to manage human use of natural systems. It does not aim to create a system of national parks or areas separate from man's environment.

Tom Gilbert of the National Park Service is Cochairman of the U.S. Biosphere Reserve Program. "Our objective," he explains, "is to develop model research programs in Biosphere Reserves to determine the effects of man on different types of ecosystems, so that we will know how we have to change our behavior in order to keep options open for the future."

The Biosphere Reserve Program involves three stages. The first is to determine the state of conservation in the world's ecosystems and to recommend sites to be maintained as representatives of each ecosystem. Second, countries recommend and the MAB International Coordinating Council (ICC) designates suitable areas as Biosphere Reserves, according to ICC criteria. Third, these reserves, which remain under national administration and control, become bases for sharing information and expertise in a coordinated international program of conservation of genetic diversity, research, and training in natural resource management. This, of course, has the potential of strengthening national efforts in natural resource conservation and management.

There are two main types of Biosphere Reserves: the natural reserve and the man-modified reserve. Natural reserves are areas in which human influence is slight. These areas can either be representative of unaltered ecosystems, or with unusual biological features of particular interest. Glacier National Park in Montana is an example of a representative unit; Yellowstone is valued for being unique rather than for being representative. Man-modified Biosphere Reserves can be areas with long-established patterns of harmonious and stable use; degraded areas in the process of recovery; or land units earmarked for environmental management research. Such research often goes by the description "manipulative," because it frequently calls for major alterations of an ecosystem in order to determine its response. The H. J. Andrews Experimental Forest near Corvallis, Ore., is an example of a man-modified Biosphere Reserve.

The Biosphere Reserve approach to conservation has been questioned by those who prefer a system of nature reserves. However, it is strongly felt that strict protection only of natural systems will simply result in limited ecosystem conservation. The utility of Biosphere Reserves lies in their broad approach to determining what human activities are compatible with maintenance of viable ecosystems, and which activities must be changed to ensure the long-term health of the environment. Clearly, our standard of a decent support system for human life must be ecological, not only socio-economic, however important that criterion may be to burgeoning populations in the immediate future.



ENERGY AND THE ENVIRONMENT

Chapter III

DEEP OIL

SPEARHEADED BY THE DEPARTMENT OF THE INTERIOR, the Nation's unrelenting search for oil to relieve our dependence upon foreign sources focuses on the Outer Continental Shelf.

As exploration for oil and gas advances into even deeper waters on Federal submerged lands off our shores, this is the process for leasing drilling rights in the Atlantic and Pacific Oceans, the Gulf of Mexico and off Alaska to private energy companies:

By Jim Robinson

UNDER A PROPOSED Outer Continental Shelf planning schedule issued in August 1977, the Department of the Interior plans to hold as many as 21 offshore oil and gas lease sales through 1981.

Supplementing a revised schedule which Secretary of the Interior Cecil D. Andrus had issued in the early months of his administration, the schedule called for a single sale in 1977, five in 1978, five in 1979, four in 1980, and six in 1981.

This lease sale plan includes seven in the Atlantic, two off the California coast, six in the Gulf of Mexico, and six in OCS areas of Alaska. Of the 21 projected sales on the 5-year proposed planning schedule, one 1977 sale had been held, two already had been held by mid-summer 1978, and one was delayed pending the outcome of litigation initiated by a New England coastal State.

As developed by the planning schedule, there is an approximate three-year interval between the first sale in a frontier area (where no drilling has been done before) and a subsequent sale in the same geologic province. This interval is designed to provide information resulting from exploration before decisions are made for later sale plans.

A further provision guards against a boom-and-bust cycle in affected States because the timing, ideally, would see new exploratory work being done in a given area just as exploratory work from a previous sale began to drop off. The same feature would apply to development and production phases.

Built into the planning schedule is a new step in which governors of affected coastal States are given 60 days to review the proposed sale decision before it is made final. On several occasions since this step was added, Secretary Andrus has deleted specific tracts based on requests by coastal State Governors.

All of these stages are designed to assist coastal States and their local governments in planning for the onshore impacts of offshore oil and gas exploration, development, and production.

The normal time between the first step involving the public and a lease sale varies from close to two years in previously leased areas to more than

Millions of dollars in sealed bids are opened at Outer Continental Shelf sale No. 43 at Savannah, Georgia for oil and gas exploration leases in the South Atlantic. At right: Tension mounts as energy company bids are opened and read. Under Secretary James A. Joseph, who presided, receives report on top lease bids from John Rankin, manager of the Bureau of Land Management's New Orleans OCS office.

three years in new frontier or environmentally sensitive areas.

Steps involved in reaching a decision to have a sale after a planning schedule is published begin with a request for resource reports from such involved Federal agencies as Commerce's National Oceanic and Atmospheric Administration and the Environmental Protection Agency, and in certain instances from the involved coastal States.

Next the Bureau of Land Management (BLM) issues a Call for Nominations and Comments asking companies to indicate which tracts they would like to bid on if a sale is held. The Call also asks State and local governments, environmental groups, and the public which tracts should not be leased because of resource use conflicts or other environmental problems.

Responses to the Call are used as a basis for selecting the actual tracts to be studied. A Draft Environmental Impact Statement is published; public hearings are held.

The Governors of the affected States are provided 60 days to review and comment on a proposed notice of sale prior to its final publication in the Federal Register.

Testimony and views at these hearings are reflected in a Final Environmental Impact Statement which is submitted to the Environmental Protection Agency (EPA) for 30 days before Secretary Andrus is authorized to determine if there shall be a sale, and what restrictions shall be applied to a less or if a sale is held.

Some of these steps and provisions may change as a result of legislation to amend the OCS Lands Act, but Secretary Andrus had put many of the contemplated amendments into effect in 1977 and early 1978 before enactment to ensure development of the new sources of domestic energy we so urgently need.

Probing the Atlantic

ACTIVE EXPLORATION for the oil and gas believed to lie beneath the sea on the Atlantic coast Outer Continental Shelf began March 29, 1978. In a 1976 sale of oil leases the Department accepted high bonus bids totaling more than $1.1 billion for 93 tracts covering 529,466 acres in the Baltimore Canyon area off the coasts of New Jersey, Delaware, and Maryland.

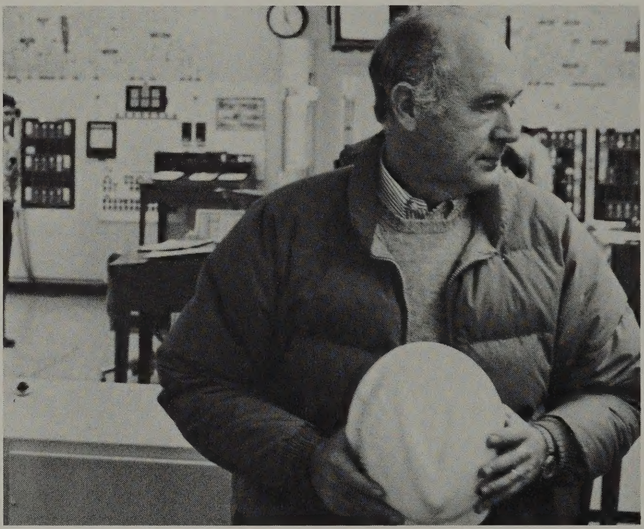
Tract development was delayed by legal action until the U.S. Supreme Court ruled February 21, 1978, letting stand a decision by a lower court validating the sale.

Secretary Andrus said at that time:

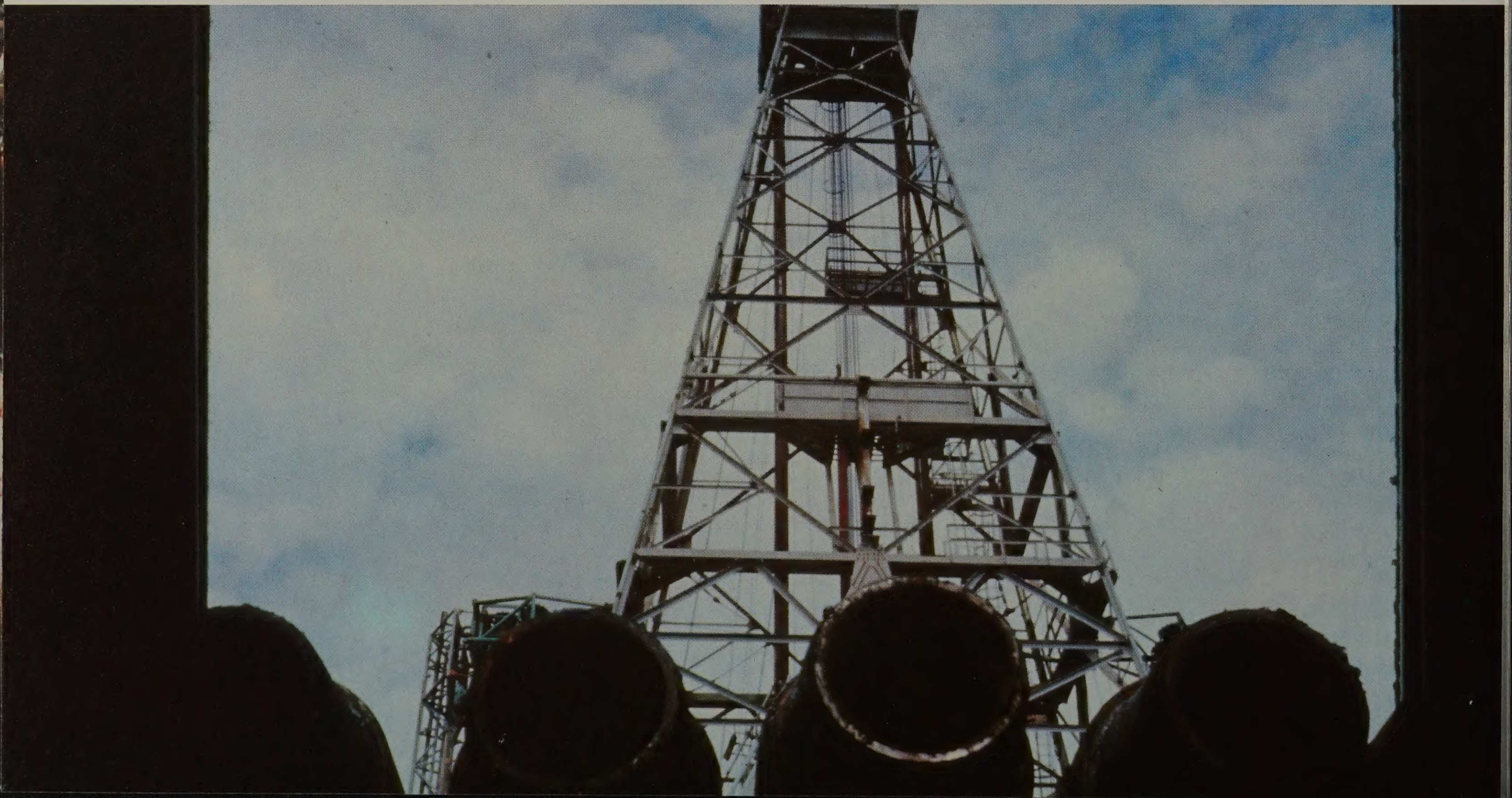
"I am delighted by the decision because it will permit us to move forward with the urgently needed task of developing our domestic oil and gas resources. All areas of the country must share in the important effort of helping to find new domestic sources of energy. Our Outer Continental Shelf can make substantial contributions to helping reduce our dependence on foreign oil and thus help reduce our foreign trade deficit.

"The requirements we have in place for exploration and development of the leased tracts will assure a high degree of protection for coastal region. We will continue to work cooperatively with the coastal states to carry out a program for OCS leasing and development which is compatible with other uses of the coastal and offshore areas."

—Andrew L. Newman.



Secretary of the Interior Cecil D. Andrus visits the control room of a Gulf of Mexico drilling platform. At right is the semi-submersible platform "Western Pacesetter II," drilling for the Shell Oil Company.



Keeping Tab on OCS

By Frank H. Forrester

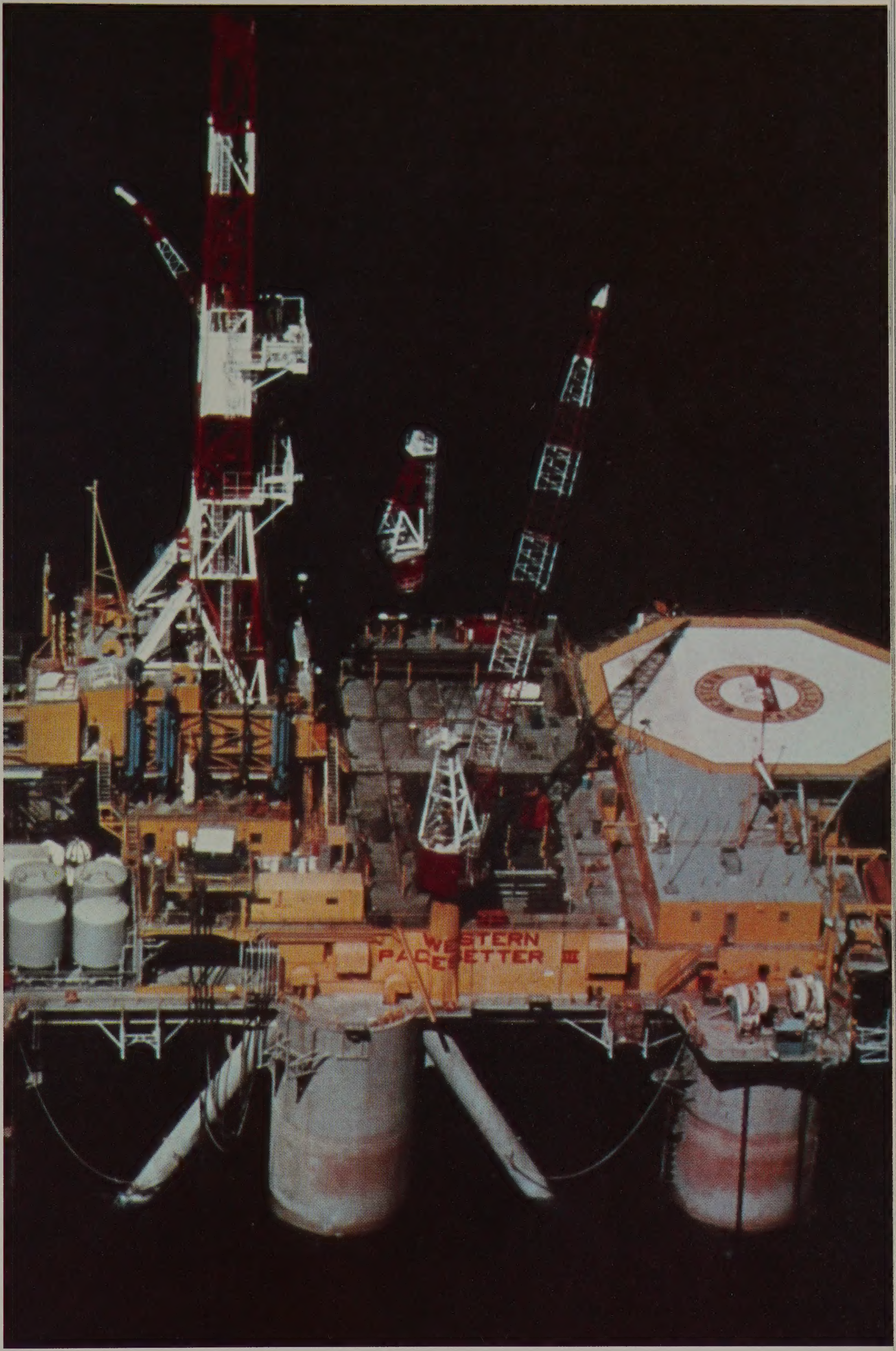
A RIGOROUS MONITORING of oil and gas operations on Outer Continental Shelf (OCS) areas of the United States is an important responsibility of the U.S. Geological Survey.

Each day, USGS inspectors fly over the Gulf of Mexico to one or more of about 2,100 oil and gas production and drilling platforms that dot the OCS in the Gulf. Their job: to see that companies holding leases are operating in compliance with Federal regulations and orders which govern OCS oil and gas operations.

The USGS—through its Conservation Division—has been supervising oil and gas operations on Federal and Indian lands since 1925. The passage of the Outer Continental Shelf Lands Act in 1953 greatly increased Survey responsibilities. The Act established Federal jurisdiction over the submerged lands seaward of the portion controlled by the adjacent coastal states (usually beginning 3 miles from the coastline) and authorized the Secretary of the Interior to lease such lands for the exploration and development of mineral deposits. Upcoming exploration and possible development on new frontier areas, such as the Atlantic OCS and offshore areas of Alaska, places a new emphasis on the Survey's supervisory and inspecting role.

Operating regulations, applicable to all OCS areas, are supplemented by OCS "Orders." Until recently, separate Orders were applied to leased lands in the Gulf of Mexico, Pacific, Alaska, and mid-Atlantic areas of the OCS. Now, however, Orders regulating the exploration, development and production of oil and gas from the OCS are being standardized and will apply on a national rather than regional basis.

The cycle of events leading to production of oil and gas on an OCS lease begins when an application for a permit to drill an exploratory well is received from a lessee. The geology of the area is reviewed as well as seismic data to reveal any unusual or hazardous geologic condition that may be encountered near the proposed well site. Reports from such reviews are used by the drilling engineer in judging the soundness of the application and its compliance with OCS Orders. The USGS district supervisor then reviews the application, which is either approved as filed or is modified or rejected. If all is in order, the district supervisor issues a drilling permit. The drilling inspection team inspects the drilling rig and insures that drilling operations meet all safety and environmental requirements.



After oil or gas is discovered, a production platform is installed. Steel pilings are driven through the legs of the structure into the sea floor for stability. Structures may vary in size from single-well structures to those with space for 50 or more wells. Equipment installed varies from a single wellhead to large, complex facilities for oil production and separation, oil storage and metering, oil and gas transfer and sales, and gas dehydration and compression. All platforms have mechanical, pneumatic, and electrical safety and pollution control devices as required by the Federal regulations and Orders. After the wells are completed and ready to go on stream, the production team inspects all producing facilities. Inspections fall under 14 major categories, many similar to drilling operations.

Some of the items checked out on an offshore rig by a USGS inspector are number and placement of life jackets and life rafts; fire-control equipment; blowout preventers; drilling-rate charts; gas detectors; pressure gauges and other well-control equipment; remote shut-down systems; alarm-triggering devices; and sewage disposal systems. Deficiencies noted by the inspector are immediately brought to the attention of the drilling supervisor. If serious deficiencies are encountered, the rig is shut down until corrective action is taken.

A Survey inspector's typical day begins at dawn with a helicopter flight to an offshore field. Approaching the nearest structures located in Federal waters, he scans the water surface for any oil spill or pollution. If a spill is sighted and the pollution originates from production or drilling operations on a Federal lease, the aircraft sets down on the suspected platform, and the inspector, working with operating personnel, attempts to determine the cause of the spill. The wells and equipment contributing to the pollution are shut-in until all repairs and corrections are made and a re-inspection is performed. The inspector's job is to inspect production equipment and procedures to insure compliance with Federal requirements.

Left are drilling platform (top), an aerial infrared photo of an oil slick in the Gulf of Mexico, and the drilling vessel "Glomar Pacific."

SINCE THE Santa Barbara, California, oil spill in January 1969, a number of substantive changes have been made in the size, scope, and procedures of the Survey's lease supervision program to prevent another spill of that type and to ensure safety and environmental protection. Some of the significant changes:

★ The inspection staff has been increased tenfold.

★ Several new OCS Orders and Notices have been issued, and others revised. Orders are constantly evaluated and revised to reflect new technical developments and new lease management policies. Procedures have been adopted for general public participation, including the affected States, of new OCS Orders and revision of existing Orders.

★ Inspection procedures have been standardized and systemized to insure consistent and objective inspections and enforcement actions.

★ A "Safety Alert" system has been established to notify all operators about the nature and cause of failures and accidents so they can take appropriate actions to prevent similar events.

★ Accident investigation procedures were revised for more definitive causes and effects of accidents. Reports of accidents are available to the public.

★ Operators are required to submit contingency plans for oil spill containment and cleanup before any drilling can begin. Large amounts of absorbent materials, booms, powerboats, and other oil containment devices are now available in the Gulf of Mexico and off the Pacific Coast through cleanup companies supported by a consortium of oil companies involved in offshore operations.

★ A Review Committee has been established under the aegis of the National Academy of Engineering to serve as an independent audit of the effectiveness of the Geological Survey's operations and procedures.

THE EFFECTIVENESS of these actions has been reflected in statistics on OCS operations. Since the Santa Barbara spill, the number of fixed structures in Federal offshore waters increased from 1,575 at the beginning of 1969 to 2,159 on July 1, 1977. During this 8½-year period, 6,800 new wells have been drilled in the Gulf of Mexico, and only four have caused a major oil spill (over 10,000 gallons). In the Santa Barbara Channel, 250 wells were drilled without incident. The total of all major accidents from both drilling and production during this period was 37, of which 19 resulted in significant oil discharges.

Despite all the improvements in regulations, equipment, and inspection procedures, there remains a small chance that accidents may occur during OCS operations. And as exploration and development take place in new frontier offshore areas, in deeper waters, and under more environmentally hostile conditions, the possibilities of an oil spill or other accident will always be present. But the Federal government, through coordinated efforts of many agencies such as the Geological Survey, the Coast Guard, and the Environmental Protection Agency, working with industry, are developing safety systems aimed at preventing accidents, containing them and minimizing effects if they do happen, repairing damages that may result from an accident, eliminating permanent environmental effects, and using the experience gained to prevent similar accidents.

(Above). Roustabouts on a Standard Oil of Indiana drilling rig. (Right). Sunset makes a striking silhouette of oil rig.

1932 Oil Outlook

THIS PASSAGE from the 1932 Conservation Yearbook, signed by then Secretary Ray Lyman Wilbur, provides a provocative backdrop to the oil and gas shortfall we are faced with today:

"It is estimated that perhaps one-fifth of the oil of the world lies beneath the surface of continental United States. That territory has been more thoroughly explored than any other. Today it is producing the lion's share—some 65 percent—of the oil used by man. It is producing this oil from a reserve of 20 percent of all the oil there is.

"There is no escaping the fact that if this procedure continues, the United States, now so well supplied, will be among the first of the oil producing nations to be permanently without that utility.

"There is general agreement that the United States has developed and produced its oil too rapidly. With the translation of the iron age into the age of oil, the scramble has been without precedent. For 10 years now, despite the increasing multiplicity of its uses, oil has been found faster than it could be consumed. All the time there has been more of it above ground than the market demanded. If during the month of June 1931, all the wells that were down to oil had been produced to capacity, they would have yielded enough of this liquid mineral to last a year.

"The presence of too much of any commodity leads inevitably to its waste, and so has it been with oil. The record of all time for the waste of a natural resource has been broken in the past decade in the oil fields of the United States.

"In California, for example, it is estimated that the loss of natural gas alone has been sufficient to have paid the national debt. Every day for years in that State enough gas (from oil fields) has been going off unused into the air to do the work of 25,000 tons of coal. The same sort of gas losses has taken place in Oklahoma, and notably in Texas. And these losses still go on. New fields have been brought in when there was already too much oil above ground. They have been produced when they were not needed. They have depressed the market and hurt the industry. They have been depleted without serving any useful purpose."

FROM EXISTING DAMS
MORE ENERGY

By Carlos S. Whiting

HISTORICALLY, the Bureau of Reclamation has had many missions and has had several changes in policy and programs. Today, the agency is again meeting new and changing needs. One of these is in electric power supply.

Reclamation got its charter in 1902 when the Congress responded to the initiatives of local, autonomous irrigation districts and communities for help in firming up water supplies. Cyclical droughts were threatening the economy and settlement of the West. Construction of reservoirs to store up winter and spring runoff for use in the hot summer created agricultural oases and thriving communities throughout otherwise arid and semiarid regions.

Other changes in the West and in Reclamation policy came with the Depression and World War II. This was a period of great multipurpose public works. Giant dams and river basin development brought ample supplies of low-cost water and electric power to the West. Metropolitan areas such as San Diego, Los Angeles, San Francisco, Portland, Seattle, Salt Lake City, and Denver boomed. For a time, spurred by economic forces, more and more was equated with better and better.

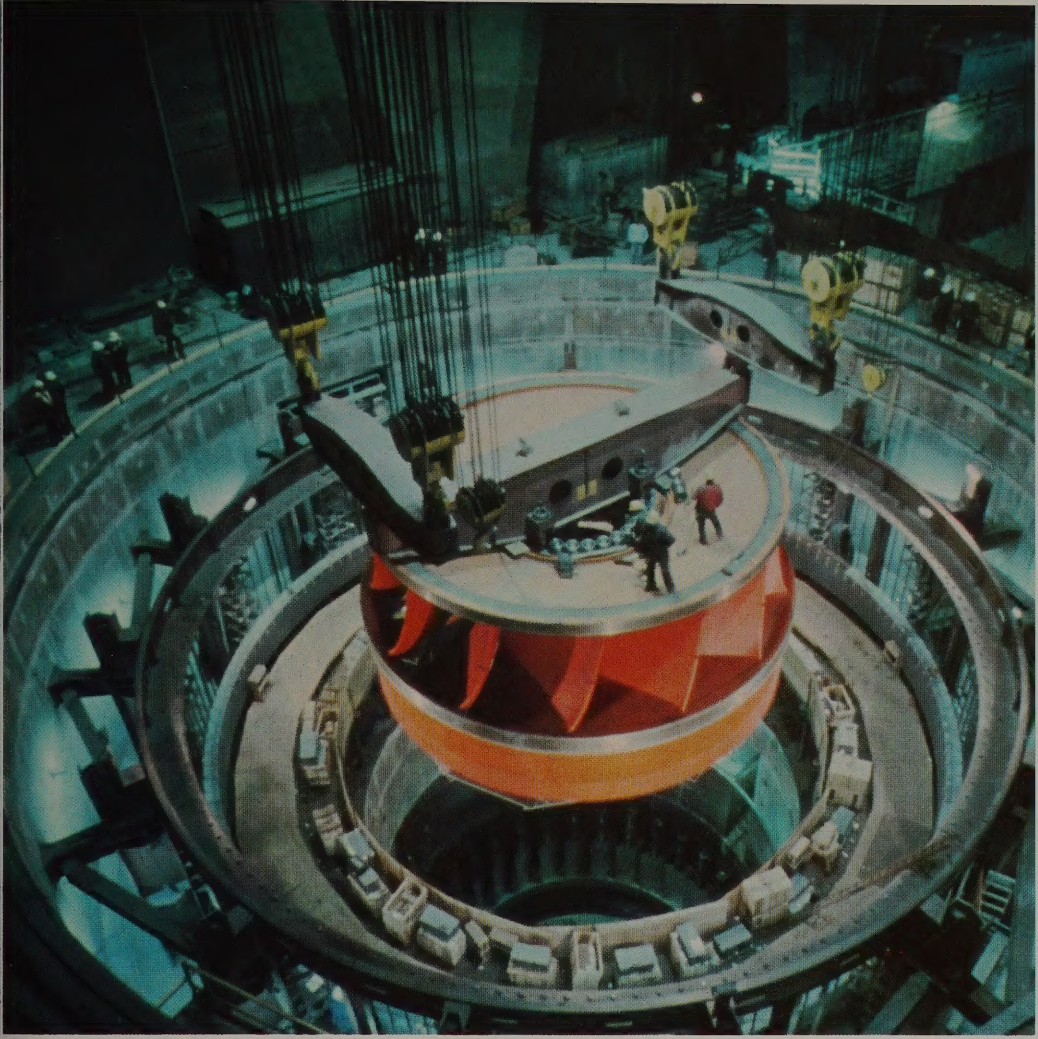
A national mood of environmental concerns and balanced growth began to prevail in the 1960s and 70s. Interior's Bureau of Reclamation along with most other local, State and national agencies — including business and industry—began to reflect changes in emphasis and programs.

Reclamation instituted a program of "Total Water Management" which emphasizes efficiency and conservation. Among new techniques are drop irrigation for some crops and automated systems for resources management, including water distribution and power transmission and generation.

Years ago, hydroelectric generators mostly supplied continuing demands or base loads. Today, Reclamation's 49 hydroelectric plants are used increasingly for meeting peak electri energy demands. Vast quantities of energy can be stored in the water in large reservoirs and released almost instantly when dropped through turbine generators. With private, Federal, and public transmission systems linked and operating cooperatively, there are tremendous potentials for savings in ga and oil which otherwise would be burned in thermal generating plants.

In the United States, there are abou 562 million kilowatts of installed capacity in all kinds of electric generating systems. Of this, about 67 million kilowatts or about 12 percent capacity i hydro. Reclamation alone has about 1 million kilowatts of installed hydro capacity, a significantly large portion o the total. The Nation's total hydro capacity produces 270 billion kilowatt hours annually, an amount that woul light 28 cities the size of San Francisco.

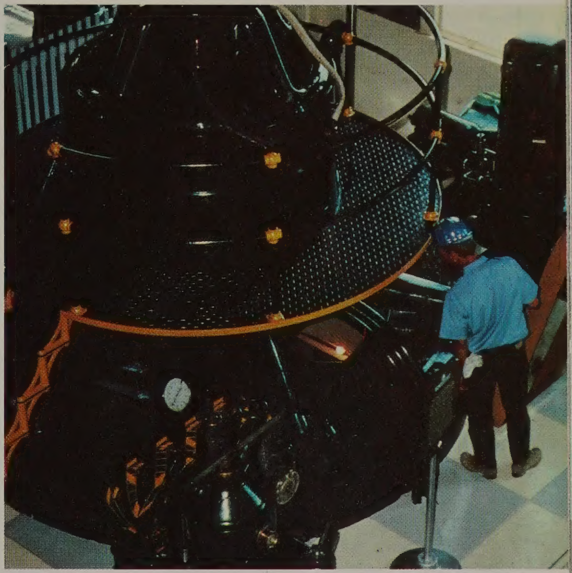
Recently, Reclamation complete studies which show that rewinding ol



Even modern multiple-purpose dams such as Glen Canyon (left) in Arizona can be upgraded to produce more electricity at lowest possible energy costs to the Nation. One of the largest and most economic turbo-generators (above) is at Grand Coulee Dam in Washington. The addition of the Third Powerplant there creates an electrical complex considered the largest and most efficient in the world.

A tremendous potential exists for small, low-head powerplants—such as this one near Yakima, Washington—without building new dams.

Another low-cost energy source is in older hydroelectric powerplants where generators can be rewound or replaced.



generators or uprating turbines at existng powerplants and/or installing new powerplants at existing water-control features could greatly increase hydroelectric capacity and energy at attractively low costs.

The costs, for rewinding and uprating, range from a low of $69 per kilowatt for rewinding generators at Glen Canyon Dam Powerplant (Arizona-Utah) to a high of $1350 per kilowatt for uprating turbines at Keswick Powerplant in California. The average cost of adding 584 thousand kilowatts of capacity by this method alone to existing Reclamation powerplants would be an extremely low $112 per kilowatt.

All this could be done without building any new dams!

In comparison, the costs per kilowatt of new installed capacity in thermal and nuclear powerplants—which burn costly non-renewable fossil and mineral fuels—range from $1,200 to $2,400 per kilowatt.

Modernizing and uprating hydro has the advantage not only in installation costs but since it is a form of solar energy it provides the bonus of being a renewable and nonpolluting source of power. It is also the fastest way to add large components of electric supply.

Other changes are appealing. A number of innovative engineers have called for Federal and private construction of more low-head and small hydroelectric generating plants. Both President Carter and Secretary of the Interior Andrus have asked hydro agencies, including Reclamation, to study and develop hydro energy at existing small dams and water control facilities where economically and environmentally feasible.

It has been estimated that a program emphasizing small dams or low-head construction potentials could very quickly add in the order of 30 percent to the Nation's present hydroelectric capabilities. This would be a significant contribution.

A low-head plant may utilize a fall of water (head) of 20, 40, or 60 feet to power small hydroturbines and generators. A high dam may have a fall of 10 times or more than that of a low-head structure with probable cost efficiencies for each kilowatt produced. However, construction sites for high dams are becoming increasingly scarce, especially when factors such as the environment, endangered species and safety are concerned.

The cost of development of low-head or small hydroelectric plants is becoming more and more competitive. This is because the benefits to be derived from such development are determined by the cost of producing electric energy by alternative means such as mineral-fuel-fired thermal powerplants. Thus, recent increases in uranium and fossil-fuel costs have caused a renewed interest in other means of producing electricity, including hydropower.

Advocates of low-head generation are not suggesting that every free-flowing stream be dammed up, nor a structure placed at every feasible site. The expressed first-priority rationale of low-head proponents is that there are literally thousands of small dams and other watercontrol structures (such as canal drops) already existing where a small generating plant could be installed.

In the Department of the Interior, the Bureau of Reclamation is the lead agency in hydro research and development, and once again—with low-head—Reclamation takes a new turn to meet new needs.

E= ENERGY SHORTAGE= WATER SHORTAG

By Donovan Kelly

THE PAST OIL EMBARGO, long lines at gasoline stations, and unusually cold winters have made many of us familiar with the realization that a shrinkage of domestic petroleum supplies can contribute to an energy shortage.

The recent drought in the West was a similar reminder that our water resources are always vulnerable to changes in weather and climate.

Shortages of key metals and minerals have driven up the prices of many household articles.

Less appreciated is the fact that all these shortages are interrelated. A lack of adequate water or the right minerals could trigger an energy shortfall, or a lack of adequate energy resources could hamper use of water supplies or mineral production even when adequate resources are available for development.

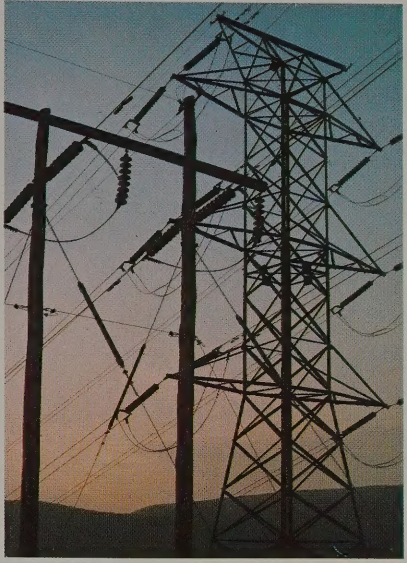
Drought in the West brought home this problem to many farmers, particularly in the Northwest. As the drought progressed, the surface water supplies in streams and rivers that normally supplied irrigation water dwindled to record low levels. Fortunately, many of the areas contained ground-water supplies in aquifers (subsurface, water-bearing rocks) that were more than adequate to supply immediate irrigation needs. Well drilling became deeper and intensified in an attempt to tap the underground water supplies. To pump these supplies required energy, however, and the normal source of energy, the electricity supplied by hydroelectric generating plants, was in short supply because of the low levels of streams and reservoirs. The irrigation farmers appeared headed for local water shortages, not so much because they didn't have an immediate source of water available, but because they didn't have the energy available to develop the water. In effect, a regional water shortage could produce a regional energy shortage which could produce a local water shortage.

Fortunately for the farmers, Canada was able to release additional water from its own reservoirs to help ease the hydroelectric power-water shortage in the Pacific Northwest until the rains finally returned.

Looking ahead, U.S. Geological Survey scientists can see tha this cycle of interrelated shortages of water, minerals, and energy is likely to become more common. Our future needs for water minerals, and energy are on the increase, but our available o known domestic supplies are not increasing as fast as the demand

IN THE CASE OF WATER, our total supply is large—but limited. Average annual streamflow in the conterminous United States a simplified measure of the total potential water supply, is abou 1,200 bgd (billion gallons per day), or about three times ou present water use, and stored underground water supplies are even larger than surface supplies. Some areas, however, already fac

Twin cooling towers (at far left) are typical of those at nuclear power installations. Across top, from left: (1) California's recent drought left this parched surface in a water-depleted drawdown reservoir. (2) Electric transmission lines carry power from hydro-electric dams. (3) These two workers are installing syphons in a lateral irrigation ditch so that water may flow to furrows of a western farm field. (4) The new Warm Springs dam and reservoir in Oregon stores water for irrigation.



MINERAL SHORTAGE= ENERGY SHORTAGE=

serious regional water shortages or "deficit spending"—using water faster than it is naturally replenished. Development of existing and needed energy and mineral resources in these regions could be seriously hampered by water restrictions.

Moreover, our water use is on the increase, and much of that increase is related to energy production. In the latest 5-year summary of the Nation's water use, USGS hydrologists estimated that as of 1975, the use of water had grown to an average of about 420 bgd, a 12 percent increase in offchannel water use (withdrawals other than for hydroelectric power) since 1970. Almost half that demand, about 200 bgd, was attributed to the generation of thermoelectric power, which showed an 18 percent increase in water use over the same period.

Looking farther ahead, USGS scientists see a continuing rise in water use to meet energy needs, and perhaps even more limiting, an even greater increase in the amount of water "consumed"—evaporated or otherwise made unavailable for immediate reuse—as we switch from petroleum to other energy sources, such as uranium, oil shale, and geothermally produced electricity. For example, the refining of petroleum to produce a million Btu's of oil fuel consumes about seven gallons of water. To produce an energy equivalent amount of reactor fuel from uranium takes about twice as much water (14 gallons), and oil shale refining to produce that much energy will probably take 3-4 times as much water (19-29 gallons). Many of the "New Generation" fuels will also consume more water in the energy conversion process. Our current use of fossil fuels (mainly oil, gas, and coal) requires about 50 gallons of water per 100 kilowatt hours of electricity. To produce the same amount of electricity, nuclear fuels will require about 80 gallons of water, and geothermal resources about 180 gallons of water.

How much will future energy availability be determined by local water shortages? A recent USGS study indicates that water supplies are generally adequate for energy industries in the East, South, Midwest, and along the seacoasts. West of the 100th meridian, however, where many of our potential future supplies of coal, oil, gas, and uranium are located, runoff is generally less than potential diversions and demands. Energy-producing industries will have to compete with other users for the limited water supply.

Despite the need for additional domestic energy sources, the competition for water will be quite real and will be faced at many of the plants being designed or under construction for converting coal to synthetic gas and producing liquid hydrocarbons for oil shale or coal in the Rocky Mountains or the Great Plains.

A water-versus-energy crunch also is shaping up in the Northern Great Plains of Wyoming, Montana, North Dakota, and South Dakota. The region includes some rich deposits of coal, but the development of this energy resource could involve huge amounts of water.

The USGS is currently involved in a two-prong study of the region's water resources—first, to determine how much water is available from the Madison Limestone and associated aquifers. Initial test well results in northeastern Wyoming indicated a potential pumping yield of about 2,000 gallons per minute. A second, deeper well in southeastern Montana, however, was much less productive, indicating a pumping yield of only about 65 gpm.

The second, and perhaps more critical part of the study, is now underway to determine what effects large withdrawals of ground water might have on the quality and quantity of the region's total water resources, including streams, springs, and shallow water supplies.

Again, it is possible that the contribution of a source of energy could be determined not by the extent of the resource but by the adequacy of supply of water to make it available.

A SHORTAGE OF another little-known mineral—lithium—also could hamper future energy plans. Although the U.S. now produces more than 70 percent of the world's supply of lithium, known reserves are not adequate to meet projected demands for the next 30-50 years, according to USGS estimates. New deposits will have to be found if some of the prospective new energy systems—including electric cars using lithium batteries, and thermonuclear fusion power plants using hydrogen from sea water as the basic fuel—are to help shift the Nation's energy load away from increasingly scarce petroleum and natural gas supplies over the long-range future.

Lithium needs over the next 25 years alone are estimated to total between 331,000 to 1,655,000 tons. This plus non-energy uses of lithium in such products as high performance lubricating greases and heat-resistant glass and ceramics could deplete known recoverable resources by the year 2000, leaving nothing for thermonuclear power development.

The USGS has begun a modest program of exploration for new deposits of lithium, with some encouraging results already. "Meanwhile," a USGS spokesman said, "a large amount of money is being spent to develop new energy-related uses for lithium based on the assumption that the mineral will be available at a reasonable price when manufacturers are ready to start up production lines. If new resources are not identified and developed well in advance of this need, however, any sudden increase in demand will be met by a spectacular rise in price because of the need to mine and mill lower grades of lithium ore. Again, we could end up with a great new energy resource whose development is hampered by lack of a particular mineral resource."

The Goal is Coal

By Edward P. Essertier

Interior's new coal leasing policy is aimed at boosting coal production on public lands, while safeguarding the environment.

THEY CALL IT "king coal," and "America's ace in the hole."

Coal constitutes 90 percent of our fossil energy resources, yet in 1977 it supplied only 18 percent of our energy needs.

President Carter, recognizing that coal is America's most underworked fuel, has called for a two-thirds increase in coal production by 1985, to more than a billion tons a year. To help achieve this goal, the Interior Department is designing a coal leasing program for our public lands which will be legally defensible, environmentally sound, and economically efficient.

Nearly half of the Nation's coal reserve base lies west of the Mississippi River, and about 60 percent of the western coal is owned by the Federal Government. Yet despite its abundance, Federal coal contributed only about 10 percent of the Nation's useable coal supply in 1977. It is likely, therefore, that if the United States is to meet the President's goal and reduce its dependence on imported oil in the next decade and thereafter, there must be a substantial increase in Federal coal production. This increase would be in addition to the normal increases in eastern coal production and that from private lands in the west.

Between 1920 and 1970 the Interior Department issued so many coal leases that they would have produced as much as 250 million tons of coal a year *if they had been worked.* Nearly 800,000 acres were brought under lease, and prospecting permits were issued for an additional 470,000 acres which might have ripened into noncompetitive leases. In 1970, however, production from Federal leases amounted to only 7.4 million tons a year. There was little incentive to produce coal up until that time because of the availability of crude oil, domestic and imported, at relatively low prices.

In 1971, the Department placed an informal moratorium on new coal leasing to discourage speculation on what already was shaping up as a western coal boom. Secretary Rogers Morton formalized the moratorium two years later, allowing only for short-term leasing under specific criteria. Under this policy, Interior issued only 13 coal leases, readjustments or modifications over the next four years. Coal leasing, as a practical matter, was at a standstill.

In September 1975, the Department released an environmental impact statement (EIS) analyzing a new coal program. However, several organizations headed by the Natural Resources Defense Council (NRDC) sued the Department, alleging the EIS failed to meet the requirements of the National Environmental Policy Act. Two years later, in September 1977, a Federal District Court held that the EIS was inadequate. The court enjoined all Federal coal leasing except for some situations where the court imposed even tighter restrictions than had been in effect under Secretary Morton's policy.

The Department initially appealed the decision, but withdrew its appeal after it reached a negotiated settlement with the plaintiffs. The court-approved settlement is significant because it allows far more leasing to take place than would have been permitted under the court order, and enables the Department to develop its long-term program. Leasing is permitted in seven specified hardship cases and to aver mine closing and job losses, or to preven

With many western coal veins near the land surface, most coal extraction from public lands will be through surface mining rather than deep mining, as is customary in the east. Some veins are as much as 40 feet thick.

the bypassing and wasting of coal which would be mined only as part of the continuation of an existing mine. In addition, the Department may process 20 preference right lease applications which appear to be the least harmful to the environment out of nearly 180 which are pending.

A preference right lease is one which can be issued noncompetitively to an applicant who, operating under a prospecting permit, has found quantities of coal that can be mined commercially. Leases which may be issued under the modified agreement involve nearly 300 million tons of Federal coal and annual production of 13 to 17 million tons. This compares with 1977 annual production of about 50 million tons of coal from Federal leases.

Through the short-term response made possible by the modified court agreement, the Department expects to meet immediate coal needs, including the development of existing leases, while relieving hardships and emergency situations.

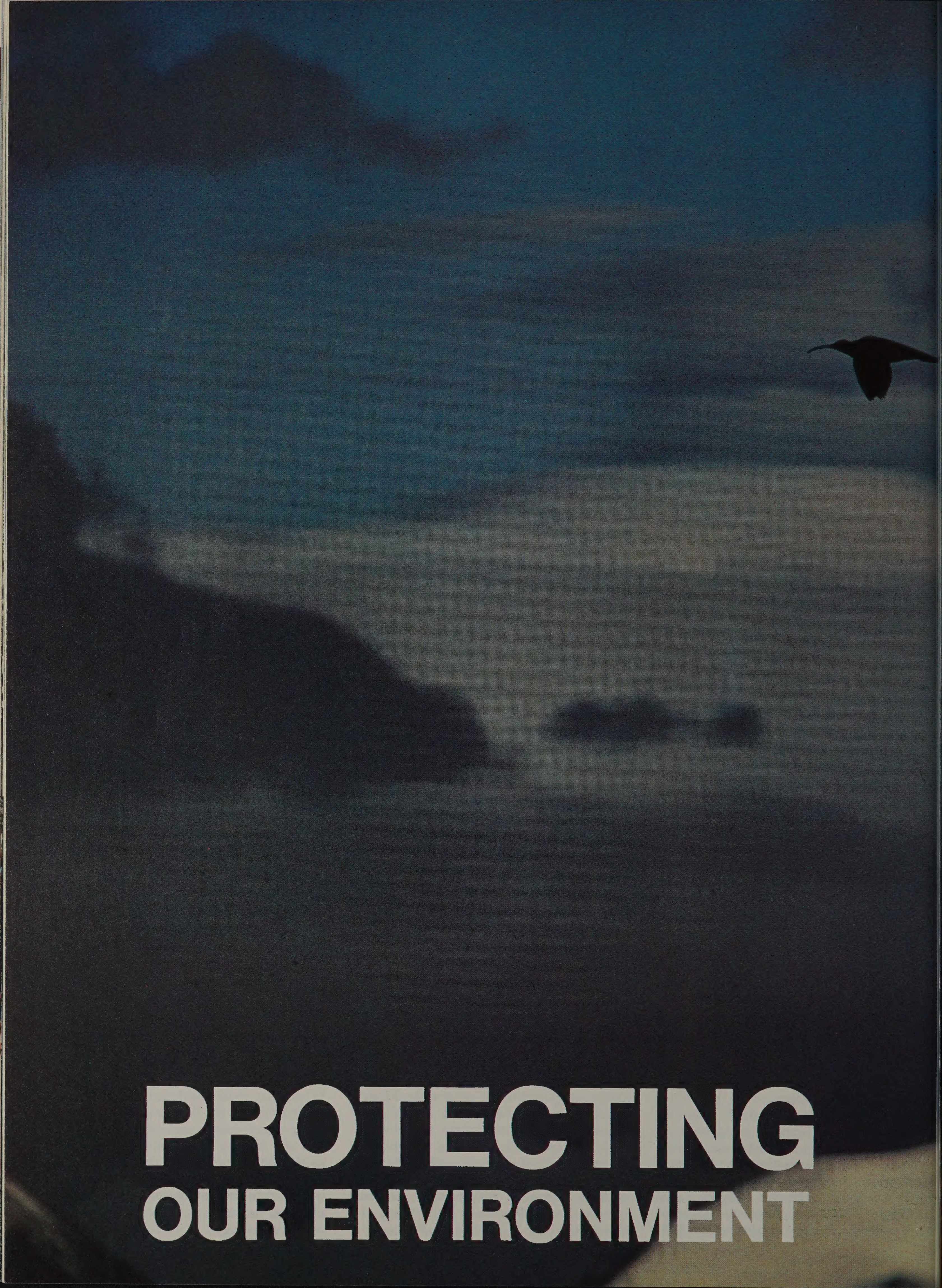
For meeting long-term needs, the Department is formulating a comprehensive coal policy to enable the Secretary to make reasoned decisions on the need for new leasing and the levels of coal production which are needed. The plan calls for a coal leasing program to be in place, supported by a legally defensible programmatic EIS, and sufficient information to identify and accomplish what major leasing is necessary, by mid-1980. To assist in reaching these goals, Secretary Andrus has established an Office of Coal Leasing, Planning and Coordination. In addition, an Office of Coal Management has been created in the Bureau of Land Management for handling the short-term program and developing the required environmental studies.

Secretary Andrus has emphasized that the coal leasing program take into account the interests and concerns of State and local officials, industry groups, environmental organizations and the public at every step of its development. Of necessity, it would comply with four recent laws which set procedures and areas of responsibility for coal management and operations.

These laws include the Federal Coal Leasing Amendments Act of 1975, which requires the rewriting of many regulations defining proper operating procedures, diligence requirements and others; the Federal Land Policy and Management Act of 1976, which charges the Bureau of Land Management with comprehensive land-use planning before leasing of the coal, and the Department of Energy Organization Act, which requires extensive coordination between Interior and the new Department of Energy.

A fourth law, the Surface Mining Control and Reclamation Act of 1977, will be significant as the leasing policies go into effect. This law contains mining and reclamation requirements to minimize or prevent the harmful effects of both surface and underground mining. Along with the first three laws, it contains vital tools to enable the Department to achieve the goals set by Congress for energy development within the framework of land and resource planning and environmental integrity.

There are no push-button solutions for devising a workable coal leasing program. By following the guidelines set by Congress and by having meaningful communication with all interested parties in the lengthy development process, however, the Department expects to have a program that will meet the Nation's coal production demands without sacrificing the legitimate concerns of all the interests affected. The President has left no doubt regarding his belief that coal must have an unprecedented role in the Nation's energy future. After many frustrating delays, uncertainties and lengthy litigation which have impeded coal leasing in the past, the Department is confident it can meet the President's priorities for returning coal to its rightful place in providing a substantial share of America's energy.

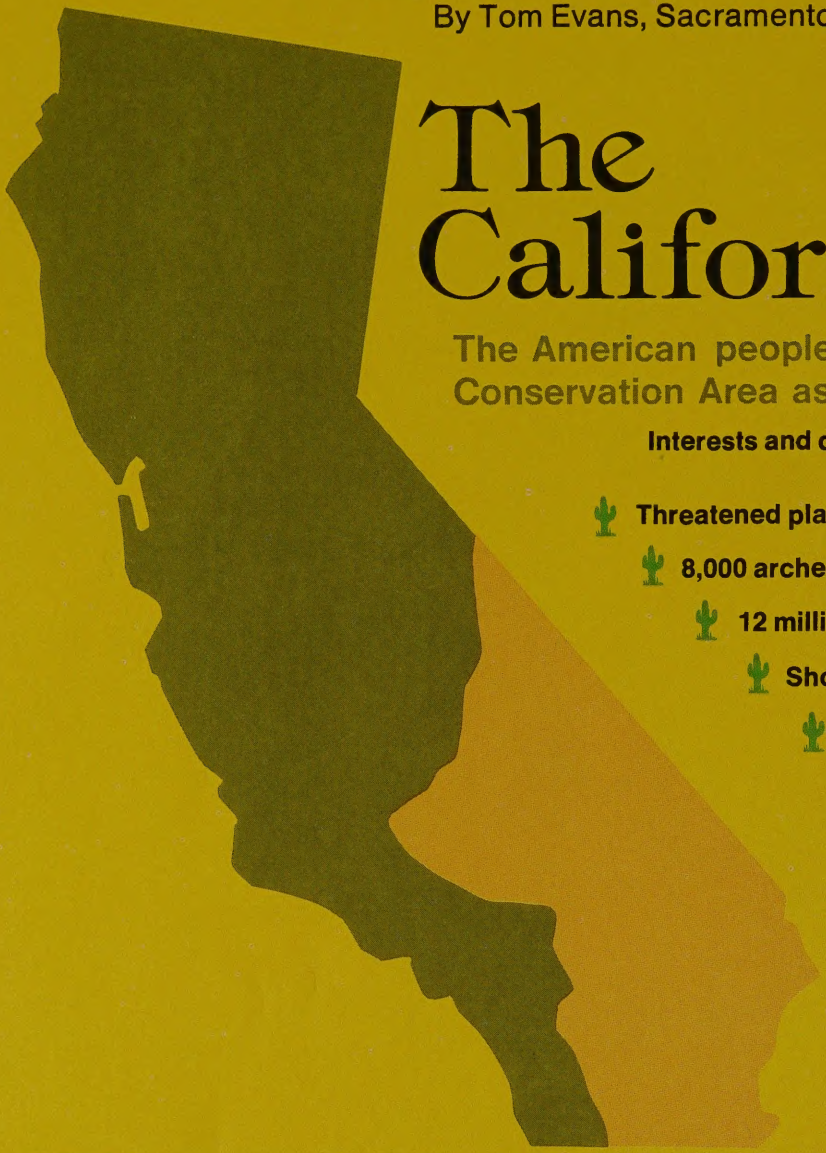


PROTECTING OUR ENVIRONMENT

Chapter IV

A Bureau of Land Management Report

By Tom Evans, Sacramento



The California Desert

The American people plead for protection of a National Conservation Area as large as three New England States.

Interests and concerns:

- Threatened plants and petroglyphs
- 8,000 archeological and historic sites
- 12 million residents within 2 hours driving time
- Short-term benefits vs long-term needs
- One Desert Ranger for each 1 million acres of BLM land
- Coordination with 100 agencies and jurisdictions

By 1980:

A far-ranging plan for protection and people use

IN 1973 PEOPLE AS DISTANT as the Eastern Seaboard wrote indignant letters to the Bureau of Land Management in Riverside, California. They told BLM that the public lands of the California Desert belonged to them, and they wanted better care taken of it!

The reason for the sizzling letters was BLM's report on widespread theft and destruction of ancient petroglyphs in the desert. Instant and nationwide reaction brought network television crews and reporters of major newspapers into broiling, remote canyons to see and report what was happening to rock etchings made by a long vanished people. The tide of reaction brought a Congressional Subcommittee to Riverside to take testimony on destruction of Indian art and other resources.

Three years later, BLM revealed massive thefts of plants from public land in the California Desert. Most of the plants were being smuggled into Arizona, which has a tough law against such thefts *within* the State. The plants—usually cacti and Joshua trees—also were being sent through black market channels throughout the U.S. and to other countries. Again, there was quick news media reaction. The camera crews came back to the desert, and angry letters poured in from all over.

Within three months the California Legislature had passed emergency legislation to help curb the thefts. Four months later the State had a comprehensive Native Desert Plants Act that makes some plant thefts a felony.

The stealing of petroglyphs and cacti continues, but at a lesser rate and under much more difficult conditions. The concern for protecting distinctive values of the desert, made evident throughout the U.S. by the two cases, is even more intense among California Desert residents. There are 450,000 of them, in 100 cities, towns, and small settlements, and a large number of these people are vigilant about protecting desert resources. Sheriffs' offices now routinely receive calls from aroused citizens to alert them to truck loads of cacti being moved along back roads toward Arizona and Nevada. There have been fist fights over freshly dug cacti and Joshua trees.

Some nationwide reaction to resource destruction in the area was to be expected but BLM managers were surprised by the numbers who reacted and the *nature* of their response. A large segment who knew they probably would never see the objects of their concern were in a lather. They insisted that *their* resources be better protected!

The dimensions of public concern were better defined in 1978 when BLM released results of a nationwide poll. The statistical sample showed that 41 percent of the adult public were concerned enough about the way the desert is used to want to express opinions. Although less than half of the sample, when extrapolated to the entire adult population, it is more than required to elect the President.

The prevalent attitude supported land uses that would preserve the natural environment. Overwhelming majorities wanted more emphasis on protection of wildlife and ecology, scenery and natural character, and areas of historic importance. At the same time, a majority would like to see less emphasis on commercial development such as motels and restaurants. A majority also wanted to see less of, or elimination of, unrestricted open areas for off-road vehicles.

Issues related to the California Desert have pumped a lot of adrenalin, especially in the last 20 years, and the end is not in sight. Even if it was merely a "desert," there are more than enough

Barstow to Las Vegas motorcycle race took its toll of fragile desert resources.

special interest groups in conflict to keep the juices flowing at high pressure. But it is much more than a desert, and it presents challenges BLM has never had before.

The enormous California Desert Conservation Area, created by Congress in 1976, stretches 500 miles from north of Death Valley National Monument to the Mexican Border, and is 200 miles wide, from the Colorado River to the fringes of the Los Angeles Basin. As big as Massachusetts, New Hampshire and Vermont combined, amounting to one-fourth of California's land area, the Conservation Area contains 25 million acres, half of it BLM administered public land. About 12 percent is in military reservations, an ideal place for military training and maneuvers. General Patton's World War II tank tracks still are clearly visible in remote reaches of the desert. Ten percent of the area is administered by the National Park Service; the remainder is in private, State, and Indian lands.

THERE ARE MANY CONTRASTS. Rainfall ranges from less than two inches annually at Furnace Creek in Death Valley to 20 inches in the Clark Mountains in the Mojave Desert. Summer temperatures of more than 120 degrees F. are usual, while freezing temperatures are not uncommon in winter. Elevations range from more than 286 feet below sea level at Badwater in Death Valley to more than 11,000 feet in the Panamint and Inyo Mountain Ranges.

Resources are abundant:

Agriculture: Irrigated private lands in the Imperial and Coachella Valleys account for about 10 percent of California's fruit, vegetable, and meat production. This is significant, because California produces about one-fourth of the entire agricultural output of the U.S. Further, BLM estimates that 20 percent of the 4 million acres of desert land it had inventoried by the end of 1977 would be suitable for agriculture if water is added.

Approximately 6 million acres of Federal rangeland in the Conservation Area are grazed by about 25,000 cattle and 140,000 sheep.

Minerals: The value of raw minerals produced in 1980 will have an estimated value of $300 million. Leasable minerals include petroleum, phosphate, and sodium salts. Saleable minerals include sand and gravel, building stone, and fill material. Minerals upon which claims may be filed include gold, zinc, and iron. There is a promising potential in many areas for geothermal steam development.

Vegetation: Of 1,200 species, up to 170 may be rare and endangered, some occuring only in the Conservation Area. Some native plants have sparked economic interest. Jojoba from the Sonoran Desert is being studied as a potential source of oil and wax. The oil may replace sperm whale oil, which is used in machinery that operates at high speeds and temperatures. Joshua tree fruit is expected to yield steroid drugs such as estrogen, cortisone, and synthetic hormones. The Mojave yucca is being exploited commercially on private lands to manufacture fertilizer and shampoo.

Wildlife: There are nearly 200 vertebrate species, ranging from bighorn sheep to the desert tortoise. Again, many of the species are found only in this area—such rare and endangered species as the Mojave chub, desert pupfish, and desert salamander. New species are being discovered. Little is known yet about distribution and habitat of many of the vertebrates. Even less is known about invertebrates.

Wildlife can be found in almost every habitat type, from the playas to the mountain slopes. Tiny fairy shrimp lie dormant in dry lakes until infrequent desert rain brings them to life. Small pupfish exist in water of 112 degrees F., saltier than the ocean. In addition to naturally occurring wildlife, there are more than 3,500 feral burros of African origin—a severe over-population that is harmful to both the burros themselves and other wildlife.

Cultural Resources: There is evidence that humans lived in the California Desert for 10,000 years or more, and in the Mojave as much as 40,000 years ago. Evidences of early habitation are arrowheads and spear points, rock rings and the incomprehensible works of art—petroglyphs, pictographs (paintings in caves) and intaglios (giant figures outlined in rock on the desert floor).

More than 8,000 archaeological and historical sites have been identified with indications that there could be more than 100,000 sites. Such abundance is fortunate. Each year hundreds of sites are vandalized, disturbed, or destroyed. It is estimated that no more than five percent of the known sites have adequate protection.

Utility Corridors: The vast reaches of the desert lie next door to the Los Angeles metropolitan area—a teeming, sprawling conglomeration of cities and towns with 12 million people—more than half California's total population. The LA Basin is home for one of every 20 Americans. Their appetite for water, electricity, petroleum, and telephone communications is gigantic. The desert lies between them and many of these necessities, so the desert provides the rights of way for delivery systems. Aqueducts bring water for hundreds of miles from the north and east. There are 3,500 miles of powerline corridors, more than 1,200 miles of petroleum and other fuel pipelines, 340 miles of underground telephone cables, and more than 100 microwave repeater sites. The demand for more and more utility corridors is insatiable.

Recreation: Flying over the crowded, smog-choked LA Basin, it is easy to imagine it as a giant ant colony. One of the major differences is in the attitude of the inhabitants. They lack the ant's ability to accept his habitat with equanimity. On weekends or holidays many escape to the desert. They come individually, by the thousands, or in organizational droves in search of shared respite from their jungle of cars and traffic lights. They have been doing it for nearly 20 years, causing a recreational phenomenon that, more than any other factor, has pushed BLM into an urgent mode of "catch-up" in planning and management.

The same phenomenon—made possible by increasing leisure time, more discretionary income, and the advent of off-road vehicles—is the underlying reason for America's growing awareness of the California Desert. While everyone concedes that almost all ORV owners are law abiding citizens, it is obvious that the ORV greatly increased accessibility of the desert, and this access made possible the theft and destruction of desert resources that previously were seldom reached. It was the *deliberate* acts that waved the red flag and made management action a necessity. But inadvertent destruction was a major factor also. BLM studies in the late 1960's showed an alarming amount of destruction to endangered plants and animals, watershed vegetation and soils, archaeological and historical sites, most of this damage a cumulative result of greatly increased public use of the desert.

There was damage to desert users, too. Motorcycles plunged into abandoned mine shafts that yawned vertically for a hundred feet or more. Dune buggies flipped and killed or maimed their passengers. People fell victim to unaccustomed high temperatures and lack of water. In some places there was competition by gyrocopters, sandsailers, sailplanes, airplanes, motorcycles, and four-wheel vehicles for the same stretch of dry lake bed. Recreational deaths and injuries began to multiply. By 1975 there were 50 fatalities and 760 serious injuries on BLM desert land. Many other hazards lurked—thousands more abandoned mine shafts—no one knows how many there are—live ordnance left over from military exercises, poisonous snakes and scorpions . . . and more ominously, people with criminal intent.

BLM's thinly manned organization was equipped to deal with grazing permits, mining claims, wildlife habitat, and a few campgrounds but, in the beginning, there was no way it could cope with the multitudes that scampered about where they wanted to—and did what they wanted to—in an area of public land as large as West Virginia—about 25,000 square miles.

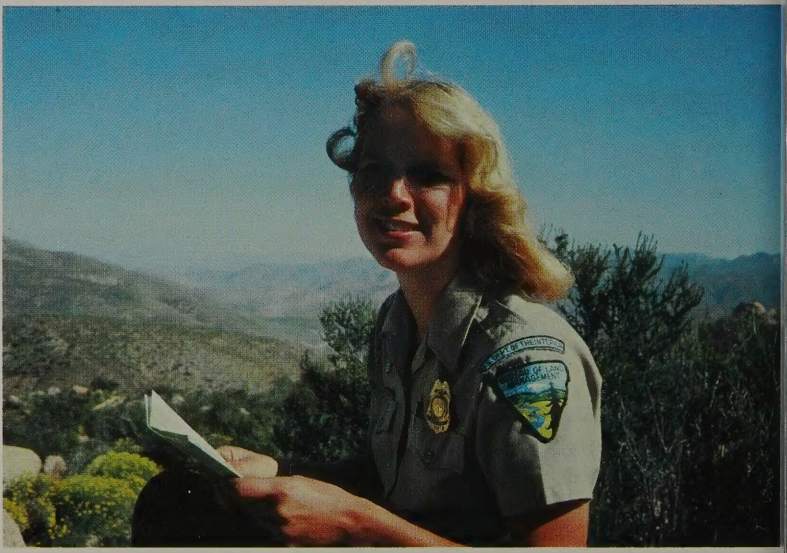
To gain the upper hand, BLM began with studies in the late 1960's to determine the extent of recreational use and the impacts recreation was having on other desert resources. The findings showed it was imperative to move quickly, on a broad front, to bring the situation under control. A two-pronged approach called the "California Desert Program" was designed. It called for an Interim Critical Management Program (ICMP) to blunt the worst abuses while a long-range comprehensive use plan could be developed for the 12½ million acres of BLM land.

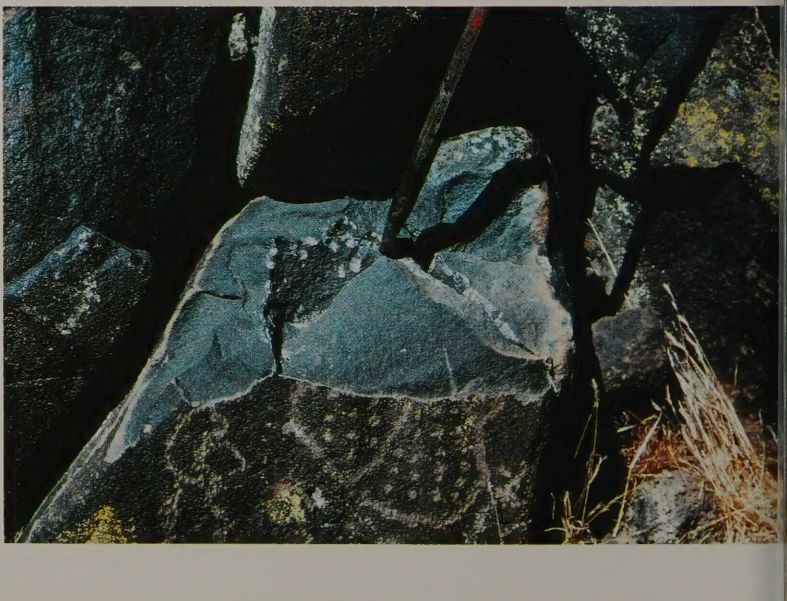
The ICMP objective was to bring recreation use under some degree of management control. It included visitor assistance and providing public information and education. These tasks fell primarily to a new kind of employee—the uniformed Desert Ranger, a resource specialist who received some law enforcement training but who was unarmed and had no arrest authority. His job was to jawbone and convince recreationists that there were good reasons not to destroy desert resources. The approach worked with most people, but soon there was little time for such contacts. To minimize resource damage, BLM began to require permits for competitive ORV events, and the Rangers had to spend the bulk of their time processing and monitoring these events.

Another main objective of ICMP was to remove ORV's from areas that were highly susceptible to damage. The nucleus of the Desert Plan Staff, hired in 1972 to begin work on the long-range plan, was diverted at once into a crash study to delineate where vehicle use should be allowed, restricted, or prohibited. The proposed vehicle use plan was presented and discussed in a series of public meetings in mid-1973. After modifications, the new controls were announced November 1 that year. One million acres were classified as "open" to ORVs. In the remaining 11½ million acres, off road vehicles were limited to existing roads and trails, or were

(Top) On desert patrol is Ranger Lynell Schalk.

(Below) This vandalized petroglyph is irreplaceable.





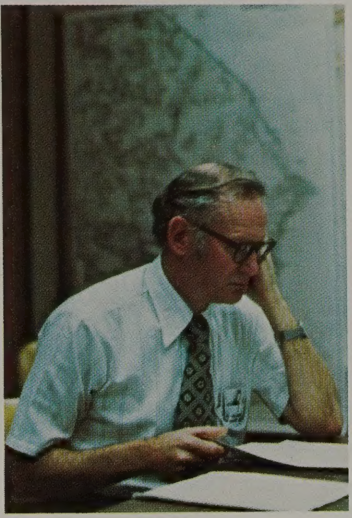
barred. Opposition was immediate. There were acts of defiance and spiteful vandalism. BLM was sued for being too lenient *and* for being too harsh. But the Courts upheld the restrictions.

Slowly the mechanism of critical management gained strength and the Desert Plan Staff began to do its intended work. The desert area was divided into planning units and detailed resource inventories begun. The first objectives were the Yuha, El Paso-Red Mountain, and East Mojave Units, totalling 4 million acres, a task estimated to take 15 years at the pace dictated by financial and manpower constraints. During that time many irrevocable commitments of resources would be made without benefit of adequate planning. Meanwhile, another concept in the wings promised a better way.

BLM's 12½ million acres were strung out and interspersed so heavily with other holdings that planning would not make much sense if it was confined only to the patchwork pattern of public domain ownership vs. other agencies and owners. It was obvious that the *entire* area should be viewed as a single planning unit—an area of 25 million acres! BLM would get the planning lead because it was responsible for much more of the area than any other agency. Since the whole point was the proper use of resources, it ought to be a conservation area. The words "California Desert National Conservation Area" fell together and the concept had a name. Next began a long selling job to make it reality.

Nowhere else had any agency undertaken a planning job with so many conflicts and so many people directly affected (12 million within two hours driving time) for such a large area, described as "the world's largest, contiguous area of dispersed, high intensity recreation use under the management of one agency."

Planning for the total area would require an unprecedented job of coordination with more than 100 other Federal, State and local agencies, and jurisdictions. The coordination was necessary if the plan was to be mutually compatible—and thus workable. Coordination would be difficult and time consuming because this was not a situation for strong-arming. BLM would have to base its coordination efforts on persuasion and demonstrated expertise.


Neil Pfulb readies his desert plan.

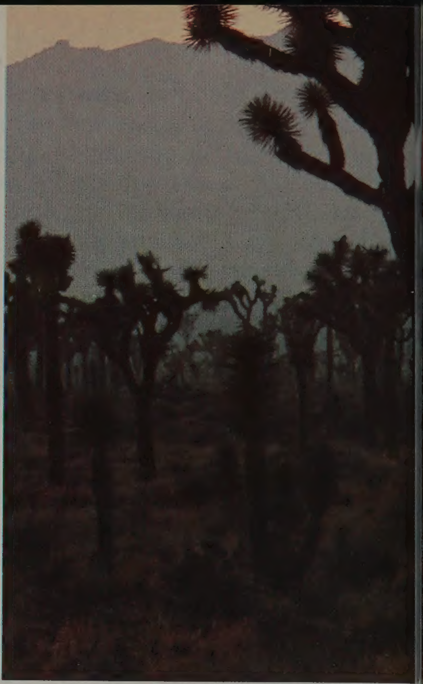
The Bureau gained a leg up on the coordination task in 1972 when it hired Neil B. Pfulb as Desert Plan Director. Pfulb had served 20 years as Planning Director for San Bernardino County, which has a large portion of the desert. He already knew many of the right doorbells to ring to expedite coordination. Two years later he won the Interior Department's Meritorious Award. He was cited for "a high degree of conceptual ability and knowledge, organizational ability, and outstanding leadership."

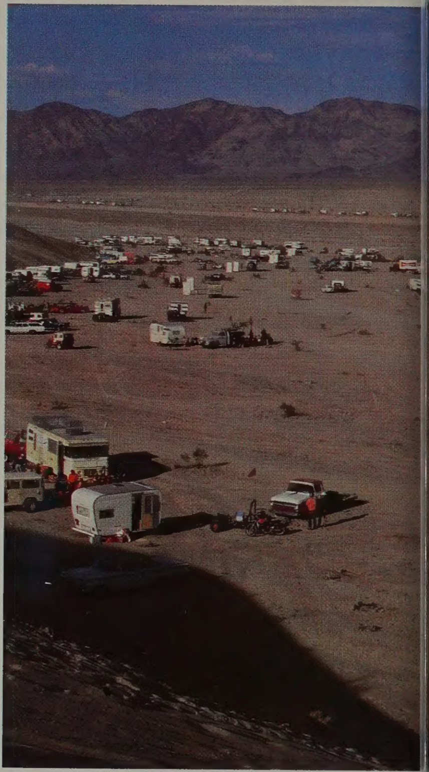
For those closest to the total area planning concept, it seemed like an eternity, but the idea became reality in late 1976. Congress passed the Federal Land Policy and Management Act. Title VI of the Act established the California National Conservation Area.

The new law directed that the plan provide for multiple uses in combinations that would best meet present and future needs, and that efforts be made to achieve and maintain, in perpetuity, a sustained yield of renewable resources.

The Act—Public Law 94-579—directed the creation of a uniformed Ranger Force authorized to carry sidearms, issue citations,

Laced with vehicle tracks, the Imperial Valley is one of the popular playgrounds for off road vehicles. Here a Desert Ranger Patrol provides visitor assistance.





Native desert bighorn sheep and wild burros compete for the same limited water and forage. Burros foul water holes and destroy habitat for the diminishing bighorn population.

Joshua tree

Recreation vehicles and campers rendezvous in the desert.

Plane picks its way through the San Diego smog.

Power transmission lines cross the desert.

Abandoned rubble marks mine site.

Dune buggies furrow the desert surface.

and make arrests. A "force" of 13 Rangers, about one for each 1 million acres of BLM land in the area, began duties in late February 1978.

Another crucial provision of the law requires extensive public involvement in making the plan. A key element of this program is the work of the California Desert Conservation Area Advisory Committee. The membership represents a broad spectrum of disciplines, interests, and desert uses, providing a major forum for public comment and proposals as the plan evolves.

Pfulb sees three primary segments of the public which will have vital impacts on the development of the plan. A variety of techniques will be used to encourage their input.

"The first segment is the general public that extends throughout the United States," he said. "We are dealing with a nationwide resource and it is meaningful to people all over the U.S., as shown by the Gallup Poll. We are working with the media, through periodic news reports and public service announcements. These efforts already are stimulating comments mostly in the form of letters. Many people are asking us to put them on a mailing list for future information. It is conceivable that we could have a list of 100,000 interested people.

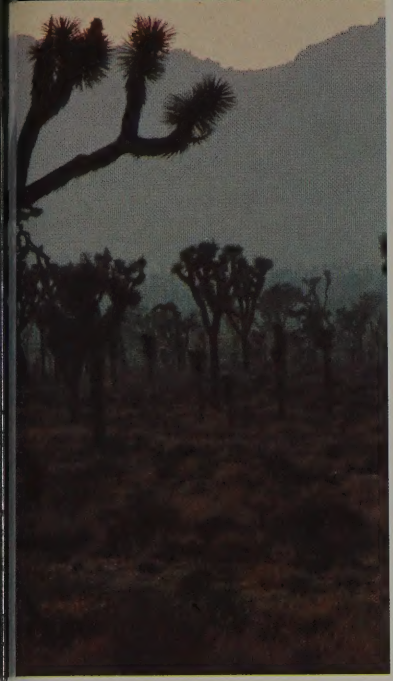
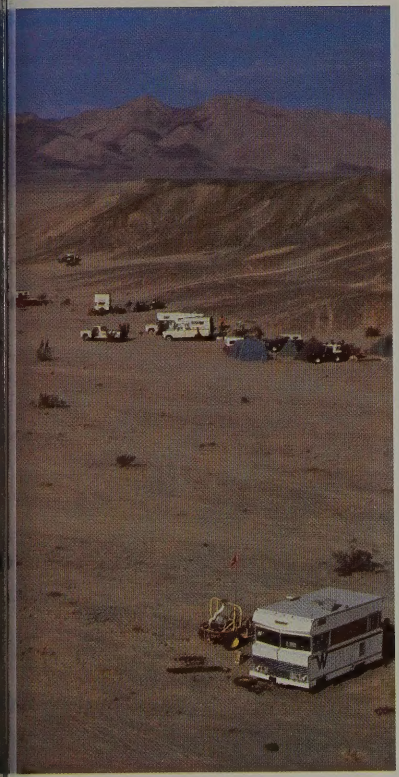
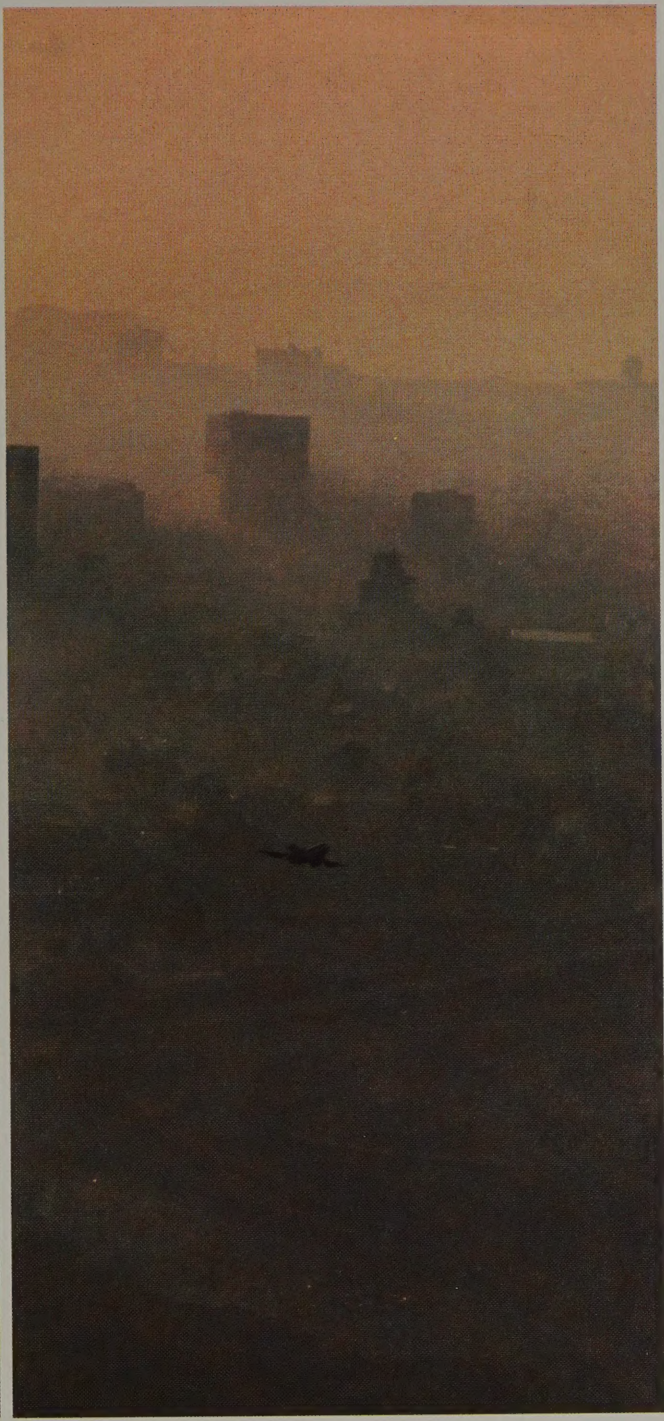
"Another segment of the public, of which we are always aware, consists of organized groups such as recreation, mining, grazing, wildlife, and nature study. Many thousands of people belong to these groups. It is comparatively easy for us to reach them and for them to reach us because they have well defined leadership. We can use various techniques with them—seminars, workshops, and their leaders can—and do—come before the Advisory Committee.

"A most important segment of the public is the people who live within the boundaries of the Conservation Area and make their livelihoods there. We reach them, and vice versa, primarily through their locally appointed and elected officials and through local meetings. By the end of 1978, contact will have been made with all of these officials."

The first two years of planning effort under the new law—1977 and 1978—have been a time of data gathering. So much information is being generated that computer storage and retrieval is the only practical way to handle the volume. To help increase the area of coverage, the staff is using remotely sensed data obtained from satellites and U-2 high flight aircraft to assist in mapping geologic features, soil types and vegetation.

"The work we did in the first five years is all usable in meeting our deadline," Pfulb said. "The planning units which we completed total 4 million acres dispersed throughout the desert, and are somewhat representative of values found throughout the area. By interpolation in combination with new information, we can provide data on a desertwide basis."

The emphasis in 1979 will be on data analysis, the development

of planning concepts and alternative uses and, finally, proposed allocation of resources. The Act requires that all resources be considered, singly and in their relationships with each other. Alternative plans for allocation must consider the impacts that different levels of use of one resource will have on all the rest.

By the beginning of 1980, the staff will have a thick document called "the plan" but it will be far from final. For the first several months of the year the plan will be submitted for public review, reaction, and input as a basis for revisions and adjustments. Prior to the deadline of October 1, 1980, the plan will be forwarded to the Secretary of the Interior.

"Due to the scope of the plan, it is reasonable to predict that there are likely to be some changes at the Secretarial review level," Pfulb said. "This is not unusual because the plan will contain a variety of alternative strategies and options, and state the consequences of each. The plan also will contain an implementation package, describing the steps needed to carry out the recommendations and, to the best of our ability, an estimate of the real costs.

"Learning what the resources are and where they are is one of the most significant products the tax dollars are buying, because without that knowledge, there can be no effective management.

"The plan will state how all of the many resources of this large area should be managed and what kinds of uses will be entertained. It will tell what kinds of additional detailed studies will be needed and what kinds of facilities will be required to enhance public use and enjoyment now.

"We are planning for the long-range future, too. We have identified the year 2,000 as our horizon year for forecasts of economic and social demands, asking our consultants to develop alternative concepts of the future against which we can array probable demands on the resources.

"There could be substantial changes in social values, and we should not try to play God by imposing our own values. We need some appreciation of what the needs and values of people will be after us, and allow a flexibility for them.

"It should be realized also that a composite of decisions by many people is not a perfect plan. Our challenge is to *understand* the area and to link rational land use allocations to this understanding. We should be aware that there will always be variations in an area so large. The plan we have in 1980 will not end the need to obtain more information to help us make better management decisions.

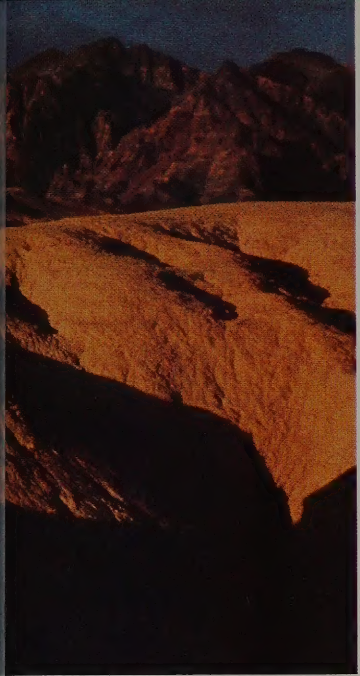
"In 1980 definite decisions will be made on land use allocations, for example, for different kinds of recreation uses and mixes of uses. We will have identified wilderness and primitive qualities that should be preserved, areas where mineral development should be anticipated, and where recreation use can occur at the same time.

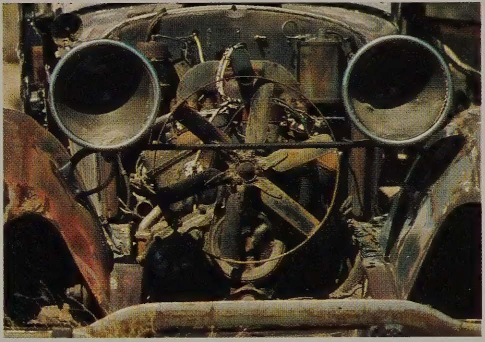
"We will recommend allocations for wildlife, allocations for utility corridors, research and education; community needs such as

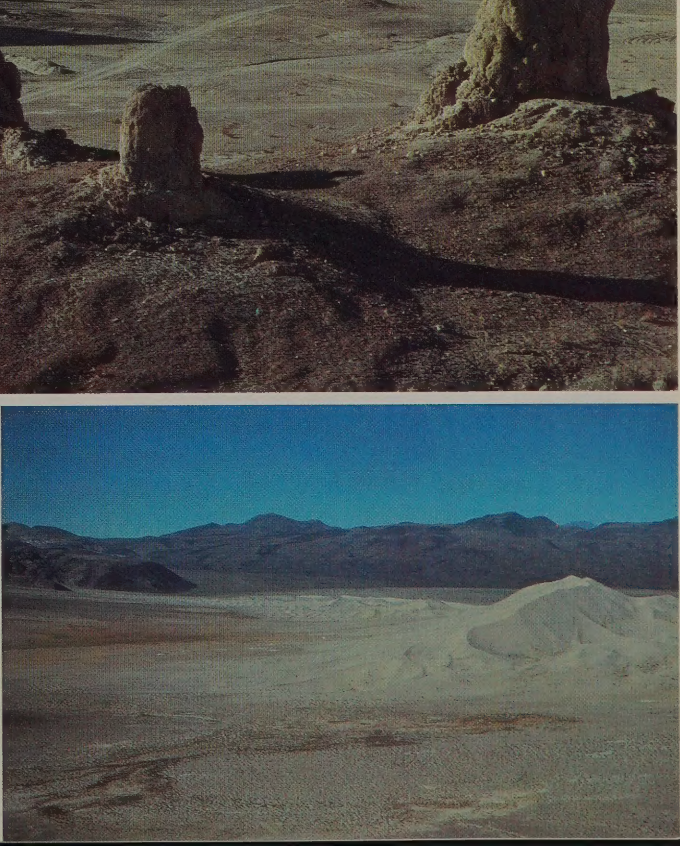
space for airports and refuse disposal; protection of rare and endangered species of plants and wildlife; preservation of outstanding areas of scenic quality; and protection of archaeological and historical sites, and watersheds.

"We will also need to be very much concerned about air quality. Our enabling legislation covers this aspect of the environment, and what we do about it could influence decisions by other public agencies and the private sector.

"The plan will try to meet as many of the expectations of the public as possible," Pfulb said, "but it must be understood that a key part of our mandate is to weigh short term benefits against long term needs. There will be disagreements about some of our recommendations and proposed allocations, but I'm convinced we will complete a meaningful and significant plan that will meet the intent of the Act and provide the Secretary with a sound basis for decisions."







Public Land Management

NEW DIRECTIONS

By Haywood Meeks

SINCE ESTABLISHMENT in 1946, Interior's Bureau of Land Management has administered one of the more complex land programs within the scope of the Federal government:

→ Responsibility for multiple use management of resources on 470 million acres of lands remaining of the old public domain—more Federal land than managed by all other Federal agencies combined.

→ Administration of mineral leasing programs on all of these lands, plus those of the submerged Outer Continental Shelf, lands held by other Federal agencies and on private lands where mineral rights are reserved to the American people.

→ Development of recreation and the protection of cultural resources on the public lands.

→ Timber resource management of two million acres of prime Douglas fir forests in western Oregon and 23 million acres of additional commercial forest lands.

→ Responsibility for the care and allotment of 173 million acres of range on the public lands, and the collection of fees from 21,000 operators who graze some nine million head of livestock each year.

→ Custodian of original patent and survey records of 30 of the 50 United States, with final authority of all survey matters involving land within, or once part of, the old public domain.

→ Fire protection on the public lands, working closely with the Forest Service and other Federal and State agencies in cooperative interagency wildfire control.

→ Disposal of land under its jurisdiction and of public domain land held by other Federal agencies.

→ Responsibility for land exchanges involving public domain and for the granting of rights-of-way across Federal lands for the construction of pipelines, electric transmission and other utilities.

In light of its multiple responsibilities and the complexity of its programs, the Bureau had needed, since its formation, a Congressional statement of policy and a modern legislative mandate for management of the public lands. Successive Presidents through the years had called for legislative reform and consolidation of more than 2,000 piecemeal land laws. It was the 94th Congress that responded in 1976 with passage of the Federal Land Policy and Management Act.

The Federal Land Policy and Management Act (FLPMA) gave the Bureau of Land Management that long needed Congressional mandate, reaffirming its legal foundation as an agency. The Bureau had been formed in 1946 by a Presidential Order which consolidated functions of the General Land Office, dating back to 1812, with those of the Grazing Service, dating from 1934. FLPMA was now the Bureau's "Organic Act," and from this new legislation, the Bureau gained new direction and authority as a land management agency.

Retention vs. Disposal

In its Declaration of Policy, the Federal Land Policy and Management Act states that with an exception for individual tracts which may be disposed of in the national

interest, it is the policy of the United States to retain its public lands in Federal ownership. This policy of retention is a reversal of the policy of disposal that dated back to the Revolutionary War.

Through the years down to relatively recent times, Congress has enacted many laws pertaining to disposal of the public domain. It was the intent of these laws to encourage development and settlement in the sparsely or unsettled areas of the Nation. All told, some 1.1 billion acres of public land passed out of Federal ownership during the first 200 years of our Nation's existence.

There are several reasons why Congress adopted a retention policy. Land left in public ownership was usually unsuited for private use—too dry, too steep, too rocky, or too infertile to provide a livelihood for a private owner. Then too, there had been great changes in public attitudes in the past decade. A concern for environmental values and open space had slowly replaced the drive for development and increased production. There had also been a growing realization that frail lands may best serve the public interest in public ownership.

This retention policy now applies to 470 million acres of public land. However, laws now on the books will make a substantial reduction in that figure when lands in Alaska are transferred to the State and the Alaskan Natives. At some future date, the public lands retained in Federal ownership will probably be in the neighborhood of 250 million acres.

The Act's Declaration of Policy also specifies several key directions for public land management that deeply affect the Bureau's missions. Among these: goals and objectives established by law as guidelines for public land use planning, and that management be on the basis of multiple use and sustained yield unless otherwise specified by law. Also, that the public lands be managed in a manner that will protect the quality of scientific, scenic, historical environmental, air and atmosphere, water resource, and archaelogical values.

Furthermore, the lands must be managed in a manner that will preserve and protect certain public lands in their natural conditions; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use.

Multiple Use

In one sense, FLPMA represent a codification of much of what the Bureau has been doing for years. This is particularly true in the case of the multiple use concept, a management philosophy adopted by the Bureau some 15 years earlier.

It established a national system of public lands to be managed in the public interest, with no one resource having a priority over others. In the process, the integrity of the environment must be maintained.

Implementation

Set against its scope, the sheer volume of actions necessary to implement the new law is staggering. The Act contains 57 sections and innumerable provisions that must be dealt with in the implementation process. Some provisions call for simple actions, but the majority call for necessary rulemaking. The Bureau is writing new regulations to cover 14 basic areas:

- Use of off-road vehicles on public lands;
- Surface management of mining claims;
- Withdrawal of lands for special uses;
- Range management;
- Procedures for land use planning;
- Regulations on selling public lands;
- Regulations on exchanging public lands for non-Federal lands;
- Rules on use, occupancy and development of public lands;
- Guidelines on enforcement of regulations;
- Procedures for granting rights-of-way across public lands;
- Review of roadless areas with wilderness characteristics for recommendation for inclusion in the wilderness system;
- Establishment of new citizens advisory boards;
- Permits and fees for commercial recreation users, and
- Revision of rules on the recordation of mining claims.

Throughout implementation of this landmark legislation, public participation is mentioned at least a dozen times in the Act. Beyond that, the Act also requires close cooperation between BLM and State and local governments, and other Federal agencies.

The Bureau seeks and invites participation by all Americans in the decision making process. This is the only way to assure the future of a part of our country's rich heritage—the public lands.

Firefighters

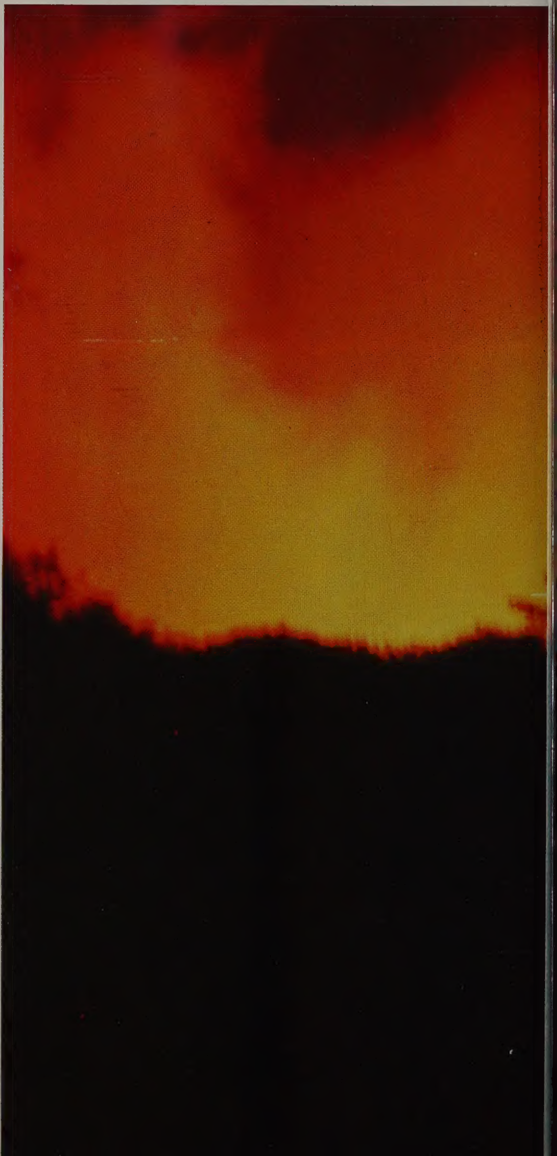
With a 'Badge of Pride'

By Grant Baugh

Their "Badge of Pride" is a shoulder patch worn by more than 500 Snake River Valley Firefighters, an elite group of individuals, mostly of Hispanic origin, who have spent the better part of 15 years establishing a reputation as one of the best trained and most effective wildfire fighting organizations in the United States. They have fought forest and range fires in 14 western and midwestern states as widely separated as Alaska, New Mexico, and Michigan. Their dream is to someday extend that range to include the entire nation.

Widely known as the SRVs, the organization takes its name from its region of origin, the lower Snake River Valley of Western Idaho and Eastern Oregon. At one time, the crewmen were mostly migrant farm laborers who followed sugar beet and onion crop cultivation northward in the spring, only to reverse the process in the fall, stopping whereever work could be found. Now, many have "settled out," establishing permanent residences in the area. Of those who still follow the migrant trail, many have two homes—a winter home in the southwest and one in the northwest for the summer. Of those who have "settled out" many are no longer with the fire control program. They have become bakers, truckers, farmers and merchants. Now a second generation works in the program to earn money for school.

The program was developed at Vale, Oregon by the Bureau of Land Management in 1963 after a serious fire season kept most of the District personnel on the firelines throughout the summer, leaving most of the planned conservation work undone. The next spring, several crews of SRVs were organized, given a few hours training, and pronounced firefighters. They worked hard, gained recognition, and grew more competent with each succeeding year. In 1970, there were over 1,400 men on the fire line at one time. Today's 20-man crews consist of 15 fire



fighters, three squad bosses, a crew boss and a liaison officer who is a regular fire control agency employee. Over the years, the SRVs have fought fires for the U.S. Forest Service, the Bureau of Land Management, the National Park Service, the Bureau of Indian Affairs, the Department of Defense, and numerous state wildlife control agencies.

Each June the crews attend an intensive two-day training session high in the Blue Mountains of Oregon. The session, jointly presented by the Forest Service, the Bureau of Land Management and the States of Idaho, Oregon, and Washington, offers instruction in first aid, which is taught in both Spanish and English. Also offered is fire behavior, chain saw operation, fire control techniques, using both hand tools and water, and helicopter operation. Some experienced SRVs receive specialized training in systems that pump water from distant streams to the fire site. Both experienced and novice fire fighters attend the training, where the old hands take the younger members under their wing and show them the fine points of wildfire control.

Raul Diaz, boss of the top crew in 1975, proudly points out that he has fought fires for 24 years and has been with the SRVs every year since they were organized. Crews are evaluated by both the fire boss and the liaison officer after each fire. For years, experienced fire bosses have filed reports commending their endurance, efficiency and discipline. "'Send them back to us again . . . Very good crew and crew leaders." ". . . I think this crew was outstanding. I would gladly have them on any fire."

In 1977, the SRVs were dispatched to 20 fires and brought home over $850,000 in wages, nearly comparable to more than $1 million earned in 1970 and again in 1971. Last year saw a severe drought in the west and with it numerous large fires. The SRV crews spent many days on the firelines in Arizona, New Mexico, California and Oregon, again rising to the tradition of the "Badge of Pride."

Let Them Burn?

By Imogene Mebane

A dry thunder and lightning storm raged over Yellowstone Park. Suddenly, a forked branch of lightning struck a dead tree in a remote part of the park. Bark exploded from the trunk. A plume of smoke soon arose; then a small but lively blaze began.

Miles away, a fire lookout spotted the smoke from his observation tower atop a mountain. He charted the fire's location and radioed the information to the park fire communication center.

But no firefighters rushed to the area. No smoke jumpers flew to it. Rangers and scientists monitored the blaze regularly, but did nothing to stop it.

No, the rangers were not failing either the forests or their responsibility. They were simply following the precepts of a fire policy, begun in 1972 and extended in 1976, that in much of Yellowstone National Park, naturally caused fires that seemed unlikely to

become major conflagrations would not be suppressed.

This may seem to be an audacious policy. In actuality, however, it is merely a recognition of the place of fire in the natural cycle.

That the "let-burn" policy applies to lightning-caused rather than manmade fires is not merely sentimentality. "A lightning fire starts at the top of a ridge, usually during a damp part of the year, and burns down slowly," says a U.S. official. "A manmade fire generally occurs in the dry months, starting at the bottom of a canyon, and moves up into the treetops."

For thousands of years, lightning-caused fires were a natural part of the forest environment in Yellowstone. They probably burned the grassy meadows every 20 or 25 years, and the tall pine forest every two or three centuries.

In this natural situation, plant and animal life adapted and endured. Some species lasted despite fires, while others adapted to the point when they won't reproduce without the occasional heat of a fire.

Along came white settlers. A little less than a century ago, the U.S. Government started trying to "manage" the Yellowstone Park area. Fortunately, because the park's 2½ million acres included some of the most spectacular marvels of the world, much of the area still exists as wilderness. Animals were allowed to roam freely. Plants grew without cultivation, design, or control. Developments and their impact were limited. Men classified rain and snow, sun and cold as agents of nature.

Fire was different. The policy of fighting all fires was established in Yellowstone in 1886. For many years, rangers were rather unsuccessful at forest fire control. Fires continued to burn on occasion, keeping young, dynamic forests in the landscapes and opening the earth to the sunlight that nurtures life.

Fires occurred with regularity (an average of 17 a year occur in the park under natural conditions) burning in a random mosaic in the park. Giant conflagrations were extremely rare. The young green forests and burns only a few years old served as natural fire breaks. Weather patterns and topography also combined to limit fire sizes.

But man was developing both the technology and determination to totally suppress all fires. A 1935 Forest Service policy stated, "Fires must be controlled in the first work period, or, if this fails, by 10 o'clock a.m. the next day."

With this desire and ability to suppress all fires, the mosaic patterns of the forest began to disappear. Forests grew older. Diseased trees became more numerous, as did insect infestations. Forests encroached on meadows, reducing the acreage of animal habitat. There were fewer wildflowers and young trees, for less sunlight penetrated the forest canopy.

For many years scientists and forest specialists had been saying that forests need fires now and again to keep healthy and to prevent fuel build-up to the stage where a giant uncontrollable conflagration is likely.

With this in mind, Sequoia and King's Canyon National Park in California first experimented with allowing some natural fires to burn in remote areas in 1968. Yellowstone began the same practice very cautiously in 1972, in

places where it was felt there was little danger of a fire spreading. All wildfires not controlled were carefully watched and constantly evaluated to determine if they should be allowed to continue to burn. Most burned themselves out rather quickly or were quenched by rain.

By 1976 scientists and fire specialists were convinced. That year most of Yellowstone's extensive wildnerness was included in the "natural burn area." The official policy is to suppress all man-caused fires and all fires that endanger human life, developments in the park, or private lands outside the park.

In the 1.7 million acres classified as natural fire areas, however, most lightning-caused fires are not suppressed. They are monitored on-the-spot as well as from fire lookouts, ranger stations, and aircraft. Specialists carefully consider weather, spread potential, public safety, size of fire, and related factors in determining whether or not to suppress each fire.

What has happened to Yellowstone's forests under this policy? In the five years since 1972, 36 fires have been allowed to burn naturally in Yellowstone with no suppression efforts made. Of these, only seven grew to be larger than one acre. Expressed in other terms, over 80 percent burned themselves out before they burned even one acre of Yellowstone's nearly 2½ million acres.

The largest natural fire occurred in July 1976 along the Continental Divide, burning about 1,500 acres. Two months later, in September, visitors to that burned area found wildflowers blooming (the roots survived) and grasses resprouting. Shrubs and small trees such as alders and willows had survived and were greening.

Other fires follow similar patterns. Don Despain, National Park Service botanist, has noted that just one season after a natural fire willows and snowberries are resprouting, young aspen are thriving, and wildflowers and grasses are healthy. Deer and elk are abundant, for they have young plants upon which to graze. Woodpeckers—even rare varieties—are newly present, having found homes in burned trunks. After the woodpeckers peck holes in the fire-scarred trunks, bluebirds and swallows move into the area. All of these find abundant food and homesites in a post-fire environment but exist only in small numbers in old forests.

After two years a burned area can be a sea of wildflowers, nourished by sunlight and by minerals in the ashes of the old forest. Brushy young pine seedlings (some pine cones need fire to release seeds) and other trees are pushing their way upward between the flowers and grasses that form forage for the animals. Birds and animals are more numerous than before the fire.

The cycle continues. Soon the fire-scarred trunks rot away. Plants increase in numbers, diversity, and size, forming a mountain environment of abundance and beauty.

In a matter of years, the trees will again crowd together and close to form a shady, older forest where new growth is limited. Eventually another fire will occur, and the cycle will repeat itself. This is the way the forest ecosystem grows and survives.

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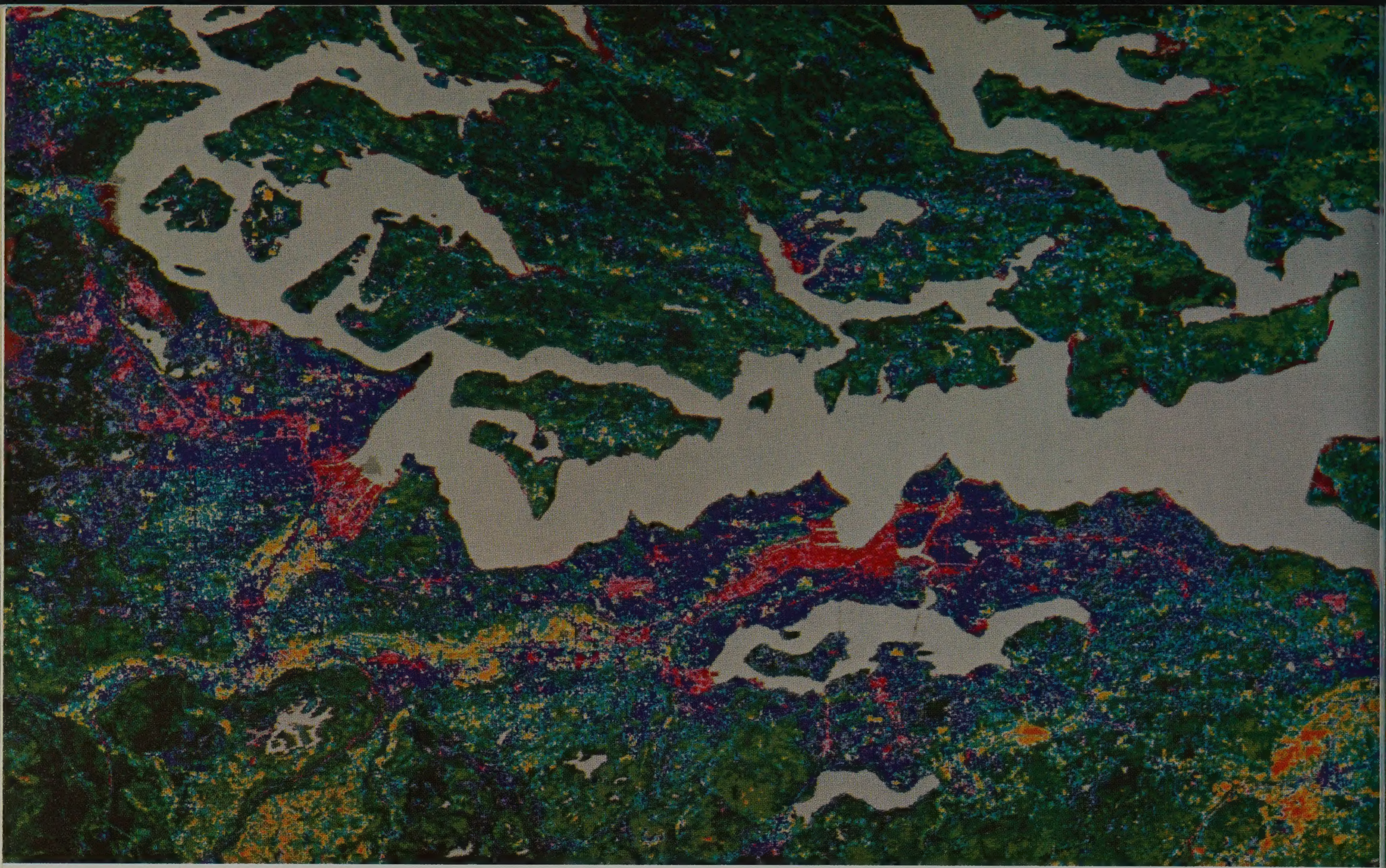
Imogene Mebane is the wife of Alan Mebane, Chief Naturalist at Yellowstone National Park.



(Above). This Puget Sound area land cover map was prepared by computer processing of Landsat data. Seattle is at center.

(Right). The magnitude of land use change through both onshore and water oil and natural gas development in the Cook Inlet area of Alaska is revealed in these aerial photos.

Land Cover Maps

GUIDES TO LAND USE

By James R. Anderson,
Harry F. Lins Jr., and
James R. Wray

The Nation's environment is dynamic, with great contrasts in environmental conditions. Knowledge about the environment—regional differences that exist, and rates and trends of changing quality that occur—is essential if the Nation is to overcome problems associated with haphazard and uncontrolled growth: declining air and water quality; loss of prime agricultural lands; destruction of wetlands by industrial, agricultural, residential, and recreational development; and damage to both land and water resources from mining of coal.

One of the prime requisites for better use of our land resources and the maintenance of environmental quality is information on existing land use and changes in land use with time. An understanding of the present distribution of agricultural, recreational, and urban land; knowledge of how and where urbanization and other development has been occurring; and data on the proportions of a given area recently devoted to different uses are used by legislators and State and local officials to determine land use policy, and by planners to project transportation demand, to identify areas where future development pressure and problems will be greatest, to estimate future requirements for facilities and to develop more effective plans for development of entire regions.

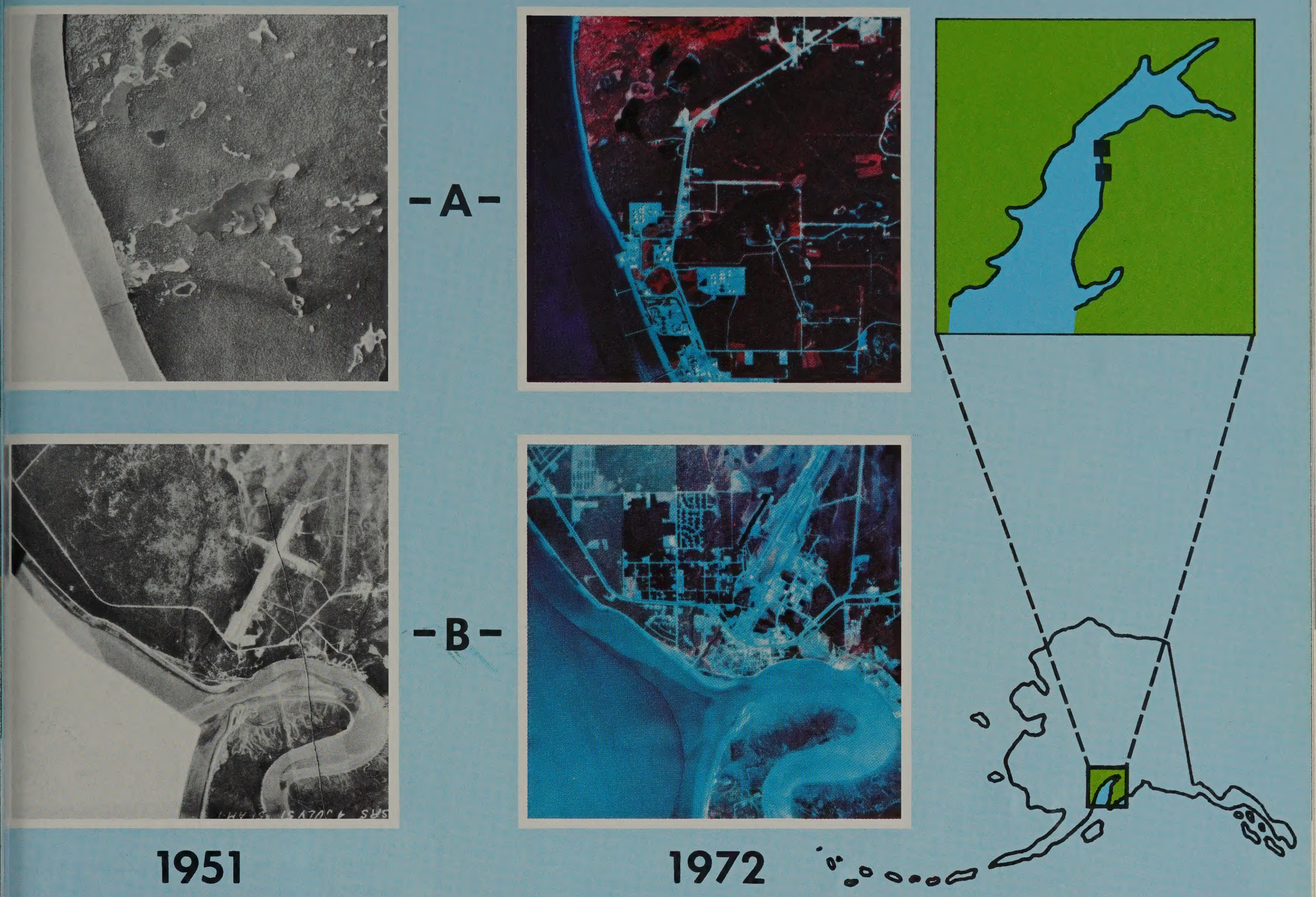
Information on existing land use and changes in land use is needed for water-resource planning. As land cover is changed from agriculture or forestry to urban uses, surface-water runoff increases, flood peaks become sharper, surface and ground water quality deteriorates, and water use increases—thereby reducing water availability. By monitoring and projecting land use trends, it will be possible to develop more effective plans for flood control, water supply, and waste water treatment. Adequate protection of the environment requires adequate programs to accommodate such needs.

To be effective, land use information must be constantly updated. For example, the assessment of recreational needs and opportunities requires knowledge of the location and extent of urban areas and potential recreational lands. Federal uses of land use data include assessing the impact of energy resource development and of water resource and river basin planning, managing wildlife resources, studying changes in the use of lands in the migratory bird flyways, and preparing national overviews of changes in the use of land for national policy formulation.

Another application of land use data is in assessing the impact of natural disasters such as floods. Statistics on the acres of agricultural, residential, industrial, and other types of land inundated by floodwaters would be valuable in estimating damages, future crop losses, and consequent economic impacts.

The Geological Survey is now compiling land use and land cover and associated maps for the entire United States. Once the bench-mark series of maps is completed, updating will provide a much-needed tool for analyzing trends, environmental and economic problems in local and regional areas throughout the entire United States, and changes in land use patterns.

Land use and land cover maps are organized under a classification system with nine general categories that are further subdivided into 37 more specific groupings. Aerial photographs and other remotely sensed data serve as the pri-



mary sources used in land use and land cover maps. The maps are compiled using base maps of the U.S. Geological Survey at scales of 1:250,000 (1 inch on the maps represents about 4 miles on the ground) or at the new map series metric scale 1:100,000 (1 centimeter on the map represents 1 kilometer on the ground).

An example of how maps derived from aerial photographs along with field-collected data can be used effectively to evaluate the magnitude and types of onshore impacts of offshore oil and natural gas development is illustrated by a study made of the Kenai Peninsula in Alaska.

Using the USGS classification system, maps were compiled for the Kenai-Nikiski area for time periods that coincide closely with (1) pre-petroleum development (1951); (2) onshore petroleum development (1961); (3) offshore petroleum development and associated onshore facilities construction (1967); and (4) offshore development drilling decline (1972). Before the discovery of oil and gas, the Kenai area underwent very little urban growth. It was essentially a homesteading area with no industry except for commercial fishing and associated canneries.

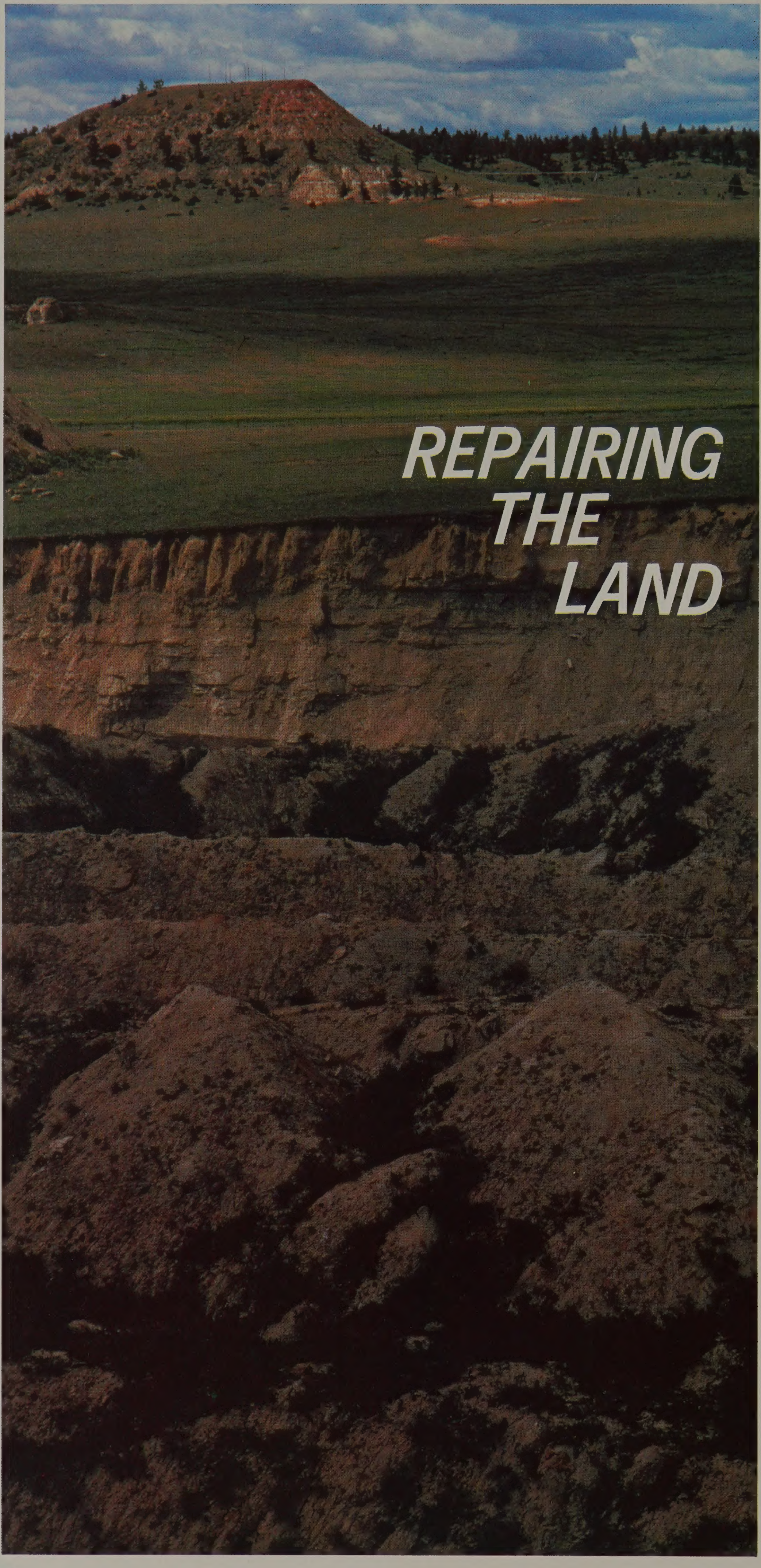
The magnitude of change in the Kenai-Nikiski area resulting from both onshore and offshore oil and natural gas development is shown very clearly on land use maps made from aerial photographs. Most of the land use change has resulted from the offshore industry. At the time these changes occurred many local decisions had to be made that related to the protection of environmental quality in an area undergoing rapid economic development. More earth science information, including land cover maps, would have aided land planners and developers in taking necessary steps to protect a fragile environment.

Aerial photographs and imagery obtained from earth-orbiting satellites such as Landsat can be used to analyze the distribution and types of environmental changes resulting from offshore oil and gas development. Such studies of land use patterns and trends are needed to decide what should be done to obtain a proper balance between economic development and maintenance of environmental quality.

The land cover map of the Puget Sound region was prepared by computer processing of Landsat data in digital form. This rendering is not just a Landsat image. Geographers have translated the various spectral signatures obtained by the multispectral line scanners aboard the Landsat satellites into a land use and land cover map. Residential land is shown in blues; pavement, commercial, and industrial lands are shown in reds. Together, these outline the built-up urban areas around Tacoma (south), Seattle (center), and Everett (north). Forest lands are shown in greens; agricultural lands are shown in yellow; clear water is gray and turbid water dark gray.

A careful study of this map reveals much useful information about the environment and how it is being used. Such information is needed to understand the environmental patterns of the Pacific Northwest and how man's activities are affecting environmental quality. Planners in this region, for example, are confronted not only with the gradual conversion of agricultural and forest lands to urban areas, but they must also cope with the sudden influx of Alaska oil to coastal refineries and development of the Trident submarine base on the Hood Canal. Understanding existing uses of the environment is the first step in finding ways to maintain balance between the economic use of natural resources and environmental quality.

REPAIRING THE LAND



By Patricia Foulk

IT WAS LATE April in western Kentucky, but you couldn't prove it by the weather. Warm spring breezes had given way to bone-chilling gusts. Icy rain pelted the white dogwood, driving fragile blossoms down the hillside in swirling rivers of watery gray mud. A thick blanket of fog enveloped a strip mine haul road in Hopkins County, playing havoc with the convoy of passenger vans snaking along its surface.

Perhaps not an untypical day in coal country. But this was no typical caravan. Packed into the vans were the first cadre of 29 Federal surface mine inspectors and the group of Interior Department attorneys who were to help them enforce the Surface Mining Control and Reclamation Act. Their rainy day mission: to conduct the first mock Federal inspection of a surface mining site.

Rained-on parades and rocky roads are familiar happenings for personnel of Interior's newest agency, the Office of Surface Mining Reclamation and Enforcement (OSM).

OSM was created in the summer of 1977 when President Carter signed the first Federal surface mining law, in White House Rose Garden ceremonies. That date marked the culmination of a 10-year struggle to place uniform Federal controls over the strip mining of coal.

(Left) Congress has stipulated that coal strip mining be balanced with environmental protection.

(Top Right) The Surface Mining Control and Reclamation Act calls for the restoration of surface mined land long since abandoned. Strip coal is assessed 35 cents per ton; underground coal 15 cents.

(right) New practices are being introduced in the coal industry to reclaim the land immediately following surface mining.

The purpose of the Act is to establish a nationwide program to protect society and the environment from the adverse effects of coal mining operations, to establish minimum national standards for regulating the surface effects of coal mining, to assist States in developing and implementing regulatory programs, and to promote reclamation of previously mined areas.

Regulatory activity will be carried out by the States, under programs approved by the Secretary of the Interior. A full Federal program will be implemented in a State only after that State has failed to submit an acceptable program of its own.

Congress also called for maximum public participation in programs established as a result of the Act. Above all, Congress stipulated that environmental protection should be balanced with the nation's need for coal as an energy source.

Thirty years ago only 10 percent of the nation's coal came from surface mines; now the figure is more than 50 percent. President Carter's energy program calls for an increase of two-thirds in coal production to more than one billion tons a year by 1985.

This extraction, however, comes with a price. Nothing could be in more startling contrast to that luxuriant Rose Garden setting which marked the beginning of Federal surface coal mining controls than a typical surface mining operation.

Down the West Virginia Turnpike, hidden behind lush green mountains and smoke-draped hollows, in the country where hardtop roads turn to dirt, a bulldozer strips away layers of earth to reach a coal seam, following the black ore around the contour of a mountain. This leaves a gash, similar to a cut made for a road across the face of the mountain. Power shovels scoop up the coal that lies exposed. Then augers, with huge rotating bits up to seven feet in diameter, bore into the mountains to bring out the remainder of the seam.

Across the mountains in the rolling hills and fertile valleys of agricultural Ohio, the world's largest earth moving machine, 32 stories high and consuming enough electricity to supply a small town, gobbles up the earth, spewing out boulders and soil to get at a vein of coal.

To rectify adverse effects of past mining operation and to alleviate dangers to public health and safety through Federal and State reclamation programs, an Abandoned Mine Reclamation Fund was established from fees assessed coal mine operators.

A sliding scale fee was established with maximum fees of 35 cents per ton of coal produced by surface mining, 15 cents per ton for underground mining, and 10 cents per ton for lignite.

Top priority projects for remedial action by the fund are abandoned sites which, in their present condition, are active hazards to public health and safety. Problem conditions include unsafe impoundments and wastebanks, subsidence in urban areas, mine or wastebank fires adversely impacting urban areas, and mine drainage discharges that degrade potable water supplies.

Charged with administering the new law, Interior's OSM developed a two-phase regulatory program. Phase I, the interim program, was introduced in the *Federal Register* in December 1977. Under this initial regulatory program, certain specified environmental performance standards began on February 3, 1978, for new mining operations; with existing operations required to comply by May 3, 1978.

These standards include: restoring mined land so that it can support its original use or an approved higher or better use; restoring mined land to its approximate original contours; removing topsoil and saving it for later replacement; controlling the placement of spoil outside the actual mining area; minimizing damage to the hydrologic balance during mining and reclamation operations; designing, maintaining, or removing mine waste embankments in accordance with regulations established with the concurrence of the U.S. Corps of Engineers; controlling the use of explosives in surface mining operations, and providing permanent vegetative cover on affected areas after mining is completed.

Special performance standards are included for mining on steep slopes, mountaintop removal operations, mining of prime farmlands, and surface effects of underground coal mining. Special provisions also apply to operations in Alaska, anthracite mines in Pennsylvania, and certain bituminous coal mines in Wyoming.

Small operators with production of less than 100,000 tons of coal in a calendar year from mines that received permits prior to the Act may receive an exemption from complying with the interim performance standards, except those governing the handling of spoil, until January 1979.

Phase II, the permanent regulatory program, was scheduled to be promulgated late in 1978. It is to include additional performance standards.

In 1978 the fledgling agency listed among its accomplishments:

- In developing the interim regulations, OSM held public hearings in four cities and later evaluated more than 300 written public comments.
- OSM officials conducted a series of seminars across the country early in 1978 to explain the new law, meeting face-to-face with almost 4,000 operators.
- The agency produced revised and more flexible regulations concerning sedimentation ponds at coal mining sites.
- More than $8.5 million was made available in Federal grants to States for FY 1978 to help them develop their own regulatory programs. On April 13 1978, North Dakota received $200,700 the first grant presented under the Act By the end of its first fiscal year, OSM expects to make grants to 24 of the 26 coal-producing States for their own programs. Excluded are only Arizona where coal mining is done on Indian lands, and Alaska, where coal mining

The Abandoned Mine Fund strives to overcome the impact of technology on coal bearing lands.

is on Federal lands.

- The agency also will be making grants totalling almost $5.5 million to 20 colleges in 20 States to support programs at their mineral institutes.
- By the end of April 1978, the first Federal surface mine inspectors had completed a special training program at Madisonville Community College in Kentucky. Most of the inspectors were hired from natural resources departments, the Tennessee Valley Authority, and the U. S. Forest Service.
- OSM opened five regional offices and announced plans for 14 district offices in 12 States. The regional offices are in Charleston, W. Va.; Knoxville, Tenn.; Indianapolis, Ind.; Kansas City, Mo., and Denver, Colo.

When he surface mines, man literally has moved mountains. The land is changed—laid bare, scooped out like a soupbowl, or rearranged into parallel ridges with the configuration of a washboard. In the process, streams and rivers become slow-moving monsters; acid kills fish, poisonous mud is deposited all over, obliterating ground cover and wildlife habitat.

By the time Federal legislation was passed, the need for a Federally-coordinated reclamation effort had become obvious. Many groups were practicing reclamation, but much of this "reclamation" consisted of nothing more than spraying grass seed on damaged slopes. Controls on such reclamation efforts were so lax that a climate developed where one industry spokesman could suggest seriously in 1971 that the scarred and stripped "badlands" of eastern Kentucky with their eerie moonscape setting be further exploited as a tourist attraction.

What can the States, the industry and concerned citizens expect when they encounter employees of OSM? Mainly two things—dedication and cooperation.

The Office of Surface Mining does not expect to correct overnight all the environmental problems imposed by lack of controls on surface mining, but with assistance from everyone—industry, the States, concerned citizens—significant progress can be made quickly, to the benefit of our country's beautiful lands and waters.

The Federal legislation sets forth a level of stewardship to our land with respect to coal mining—a fundamental moral obligation to ourselves. As Congressman Morris Udall of Arizona said in summarizing the need for this legislation, "A Nation that doesn't respect the land, doesn't respect itself."

Public Participation

The Surface Mining Control and Reclamation Act (1977) is a major environmental initiative of the Carter Administration. Similar legislation had twice been vetoed earlier. The Act provides for unprecedented public participation. As example, any citizen may petition for a public hearing on any strip mining permit, or accompany a Federal inspector on a requested inspection.—Editor.

SUBSIDENCE CONTROL

By Alan Cole

"Mine subsidence" is an engineer's term. It stands for sinking land, caused by deterioration and collapse of abandoned underground mine workings. As old mine pillars, roofs, and floors give way, the layers of rock and earth above sometimes start settling and sinking. When the phenomenon extends to the surface—as it has done in dozens of places in the United States—the land subsides. Subsidence doesn't happen everywhere there has been underground mining, but when it happens where people live, the result can be an environmental calamity—cracked foundations, tilted houses, ruptured gas and water lines, broken sewers, sagging streets, and yards with huge "potholes" that may appear suddenly without warning. Such effects are not just a nuisance, but a major disruption and a threat to public safety.

Subsidence can't be undone—but it can be prevented, or controlled.

Interior Department headquarters for work to prevent harmful mine subsidence is the Bureau of Mines. As part of its mining environmental research, the Bureau is responsible for developing better ways of combating the subsidence threat. It conducts an action program of anti-subsidence environmental repairs on Federal lands (and on certain non-Federal lands, in cooperation with State governments).

The main "laboratory" for most of the Bureau's anti-subsidence work has been the anthracite (hard) coal region of northeastern Pennsylvania, an area that has been hit hard by environmental damage in the aftermath of mining. But anthracite country is not the only area affected by subsidence, and the Bureau has been active in other subsidence-prone areas as well. Bituminous (soft) coal areas of central and western Pennsylvania, West Virginia, other parts of Appalachia, the Midwest, and the West have also been hurt by subsidence, and so have places where minerals other than coal were mined.

Against subsidence, "backfilling" has been the most effective prevention technique. Backfilling means refilling the mined-out spaces with solid material that can provide support for the geologic features above. Environmental researchers of the Bureau of Mines have successfully demonstrated several mine backfilling techniques in cities threatened by subsidence, and are working today on a new technique, as well as on refinements of methods that have already shown their effectiveness.

The Bureau's earliest backfilling successes used men-in-the-mine methods. Solids mixed with water were piped into place by underground workmen who actually directed the flow. When the water drained off, the solids remained to support overlying strata. The technique worked, but was only usable where the abandoned mine voids were accessible, and safe to enter. Unfortunately, the subsidence threat also affects land over abandoned mine workings where, because of flooding, caving, or dangerous gases, it is no longer safe for people to go down inside.

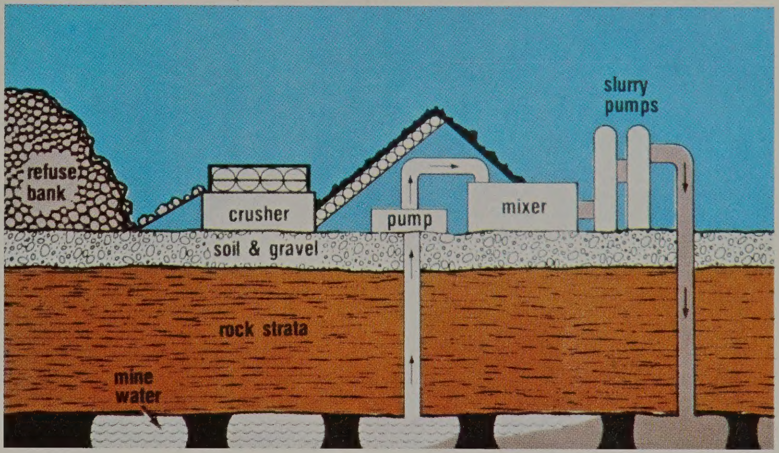
Faced with that problem, the Bureau turned to a remote backfilling technique. Holes—lots of them— would be drilled from the surface down into the bandoned mines. Solid material would be sluiced with water down the holes. The holes would be sealed when the work was through.

This "blind flushing" system worked, but it had disadvantages. Drilling costs were high, because so many holes were needed. Under each hole, the fill material heaped up in cone-shaped piles. When the top of the heap reached the bottom of the hole, no more fill could go in at that location, so gaps were left between boreholes. Thus, support was incomplete. About the best the Bureau could hope for was reasonably good support under streets and alleys, where drilling could be done, with indirect support for adjacent areas where drills could not be used.

The Bureau kept looking for a better backfilling approach, and decided to try "pressure flushing," a pumped slurry technique derived from oilfield technology for pumping solids down drillholes. Rock Springs, Wyoming, a town honeycombed with abandoned bituminous coal mines, became the test site. There, the Bureau tried backfilling some of the voids using sand mixed with water, as in blind flushing, but injected under hydraulic pressure, and with much more water. Instead of settling in heaps under the injection holes, the slurry spread out in all directions, almost completely filling the mined-out spaces from floor to ceiling. In that test, the Bureau was able to backfill abandoned workings under 200 acres using only 15 injection holes—far fewer than would have been needed with blind flushing. The engineers were eager to give the technique a try back in anthracite country.

At Scranton, Pa., the anthracite capital, the Bureau went to work on the pumped slurry backfill technique—this time substituting crushed mining refuse for the sand. From the behavior of the sand slurry at Rock Springs, Bureau engineers thought they could get the same kind of results by crushing the rocky debris from a mine refuse dump that had blighted the area for decades. Success would not only save the expense of buying sand, but would get rid of the mining waste in the most satisfactory way imaginable: by putting it back underground where it came from.

Crushing machinery was set up, temporary water lines were put in, mixers and pumps were installed, and injection began down five boreholes. To follow the underground progress of the spreading mass of fill, 43 monitoring holes were also drilled. Results: Down the five injection holes went 450,000 cubic yards of crushed mining refuse, spreading underground to protect a 30-acre residential section.



At left is a field in North Dakota with mine subsidence pockmarking the earth. (Above). This house has tumbled into a long forgotten anthracite mine shaft in Pennsylvania. At right is a diagram showing high pressure injection of mine waste slurry to stabilize residential areas, and a scene typical of backfilling abandoned mine shafts as currently practiced in Illinois and Pennsylvania.

Greatly encouraged, Bureau engineers next searched for ways to make the new technique more efficent, and extend its usefulness. For example, to economize on crushing expenses they tried injecting coarser material from mine wastebanks. The hydraulic injection system handled it effectively. They tried pressure flushing into dry mine voids—although their experience up to then had been exclusively with flooded mines—and got equally good results. Pumped slurry backfilling became the main anti-subsidence weapon.

At that point, however, a new challenge arose. When Bureau engineers were asked to help plan subsidence protection for the towns of Belleville and Maryville, in Illinois, their preliminary investigations showed that using water to carry solids into the old mine voids might actually increase the subsidence threat! The water might contribute to the instability of the clay floors in the underground workings, and accelerate subsidence instead of forestalling it. Hydraulic techniques, which had proved so successful elsewhere, could not be used at Belleville and Maryville. The risk was too great.

Bureau engineers had to search for a practical alternative to combat the subsidence threat. A logical approach to the problem was pneumatic pressure flushing —using air pressure to inject solids. In Europe, it had been done before, from underground injection sites, at coal mines that incorporate backfilling of mined-out areas with active mining operations. Thus, there was reason to hope for success in after-the-fact pneumatic backfilling of abandoned coal mines, although the Bureau needed a remote technique, with injection done through holes from the surface.

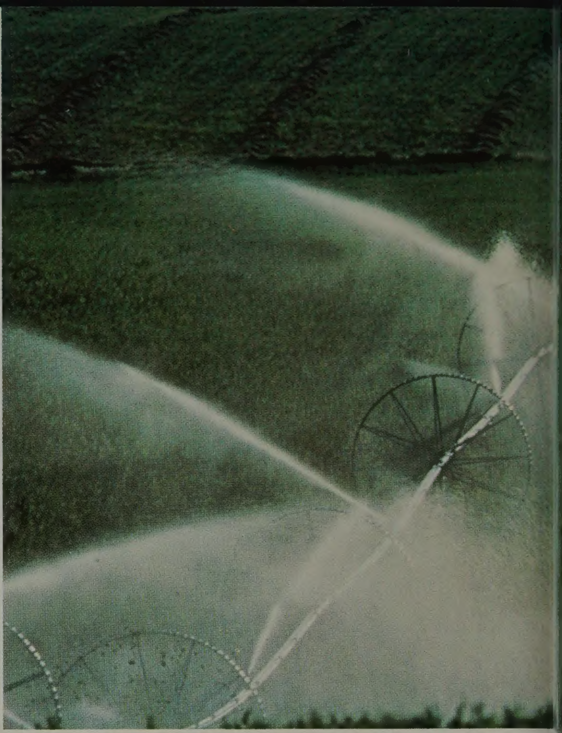
The principle of pneumatic injection is the same as that of hydraulic injection. The stream of injected solids, instead of dropping to the bottom of the injection holes and staying there, is expected to be forced past the injection sites in all directions, coming to rest only when the volume of fill deposited underground pinches off the air channels and creates a stiff resistance against additional incoming air pressure. At that point, the injection apparatus will be shut down for reconnection to the next injection hole.

State authorities were consulted and are cooperating in the project to gain experience they can use in other parts of the State. The decision was made to go ahead. Detailed plans were made, bids solicited, contractors selected, and nearby mine waste dumps targeted as sources of fill. The project officially began in late 1977. Drilling started as winter set in, after several days of delay caused by heavy snows. If the rest of the work stays roughly on schedule, the huge air compressors should spin into action by spring, forcing a steady stream of crushed solids back underground, for extra support against the threat of subsidence.

Only actual operation can show how well the project will work. To collect early clues about its performance, Bureau of Mines engineers have already made plans to lower themselves down a borehole to get a first-hand look.

Inspection will be early each Monday morning, after the compressors have been shut down all weekend and the dust has had time to settle. Dressed protectively and breathing through supplied-air respirators, the Bureau engineers will ride a portable hoist down into mine openings that have been abandoned for most of a century. What they see will be the earliest evidence about the chances for success in what they—and the rest of the Department of the Interior—hope will become a new and effective way to safeguard people and property against a major environmental hazard left over from mining operations of the past.

Bureau of Mines subsidence-control work is financed in two ways. For Bureau demonstration projects, Federal funds are appropriated by Congress for specific control programs in particular locations. For anti-subsidence work in Appalachia, costs are shared, with 75 percent paid by the Appalachian Regional Commission out of Congressionally appropriated funds, and 25 percent paid by the State.



"Water Factory 21," (left) commands national interest as a reverse osmosis plant to convert sewage effluent to high quality water. It is in the Orange County Water District at Fountain Valley, California.

In Florida, water discharged from citrus processing is successfully reused for spray irrigation in orange groves.

At right (top) are the recarbonation and sludge basin operations at the "water factory."

The Water Factory

By Francis H. Coley

AMID ALL THE concern about our limited resources and the environmental effects of man's exploitation, too little attention has been given to an often wasted resource. Billions of gallons of water are discharged annually after industrial or municipal use. Reuse of treated "waste" water has enormous potential for reducing the consumption of virgin water and for reduction of undesirable discharges into our streams, lakes, and oceans. It is essentially an untapped resource holding promise for economic and environmental benefits.

For many years water reuse has been practiced, although the fact was seldom acknowledged. Waste waters from municipalities and industries were dumped into streams or other water bodies to be pumped out and used at other locations. This "indirect" reuse was accomplished with a minimum of processing, but one user's waste sometimes rendered the water unusable for others downstream.

Recent regulations restricting the discharge of wastes have imposed a new burden on water users, and the concept of reuse soon became attractive to many of those affected. As a result, Interior's Office of Water Research and Technology (OWRT) found itself considering many proposals for investigations involving reuse of water in some situations. Several useful research projects were funded by Interior during this early period.

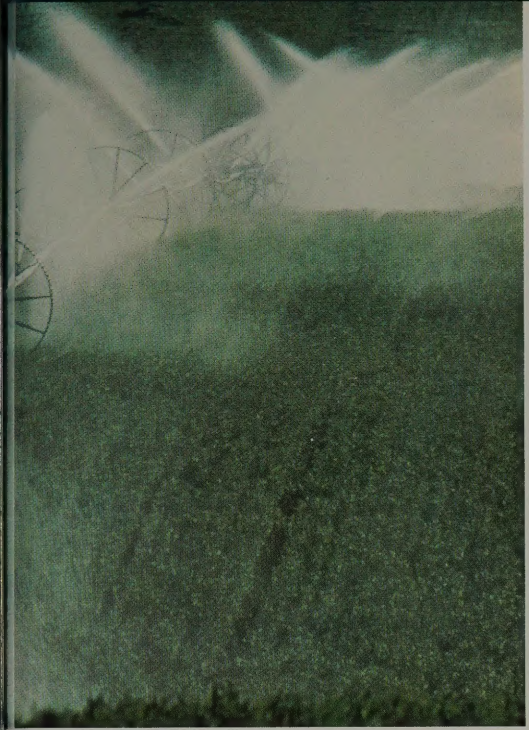
In Florida, a three-year study at the Florida Water Resources Research Center showed that it is feasible to use waste waters from the huge citrus processing industry for spray irrigation in the citrus groves. Florida citrus processing plants handle 95 percent of the Nation's processed citrus fruit, and the water discharged from the plants may exceed 130 million gallons per day. Since this discharge occurs during the region's dry season, it seemed logical to consider using the water in the citrus groves.

The Florida study was performed to permit comparisons between young and mature trees and between areas irrigated by tap water or by recovered waste. Minor probelms with mold were encountered when using waste waters, but these were found to be easy to control. Sodium buildup in the soil was feared, but this problem did not occur due to the leaching effect of rainfall during the citrus region's wet season.

In the final analysis, this irrigation project showed that some of the nutrients required by the orange trees were supplied by the waste water. Furthermore, the juice produced by the trees irrigated with waste was found to be of higher quality than that from trees irrigated with tap water!

In Hawaii, reuse of waste waters for irrigation has been the subject of study in several projects. One four-year pilot field research project involved the use of sewage effluents for sugarcane irrigation. This program demonstrated that groundwater pollution by dissolved salts and viruses would not occur in that location and gained further acceptance of the concept of water recycling as a supplement to agricultural water supplies. On another OWRT project in Hawaii, it was found that reuse of sewage effluent for irrigation of a golf course was a safe and effective means of waste water disposal.

Another water-short area, the U. S. Virgin Islands, recognized that water reuse might offer a way to stretch the meager supply of groundwater. On St. Croix, an OWRT project tested the feasibility of



using advanced treatment waste water for recharge of groundwater by ponding and by irrigation of fruits and vegetables. So successful were the tests that the results have since been used to justify an increase in groundwater withdrawal on the island.

The advent of the energy crisis also increased interest in water reuse in connection with the development of energy resources in water-short areas. In North Dakota, research was initiated to find methods for disposing of toxic waste waters from lignite liquefaction processes by recycling it back into the process or by treatment for discharge into the environment. In Colorado, studies have been undertaken to develop a water reuse program to minimize the environmental effects of *in situ* oil shale development.

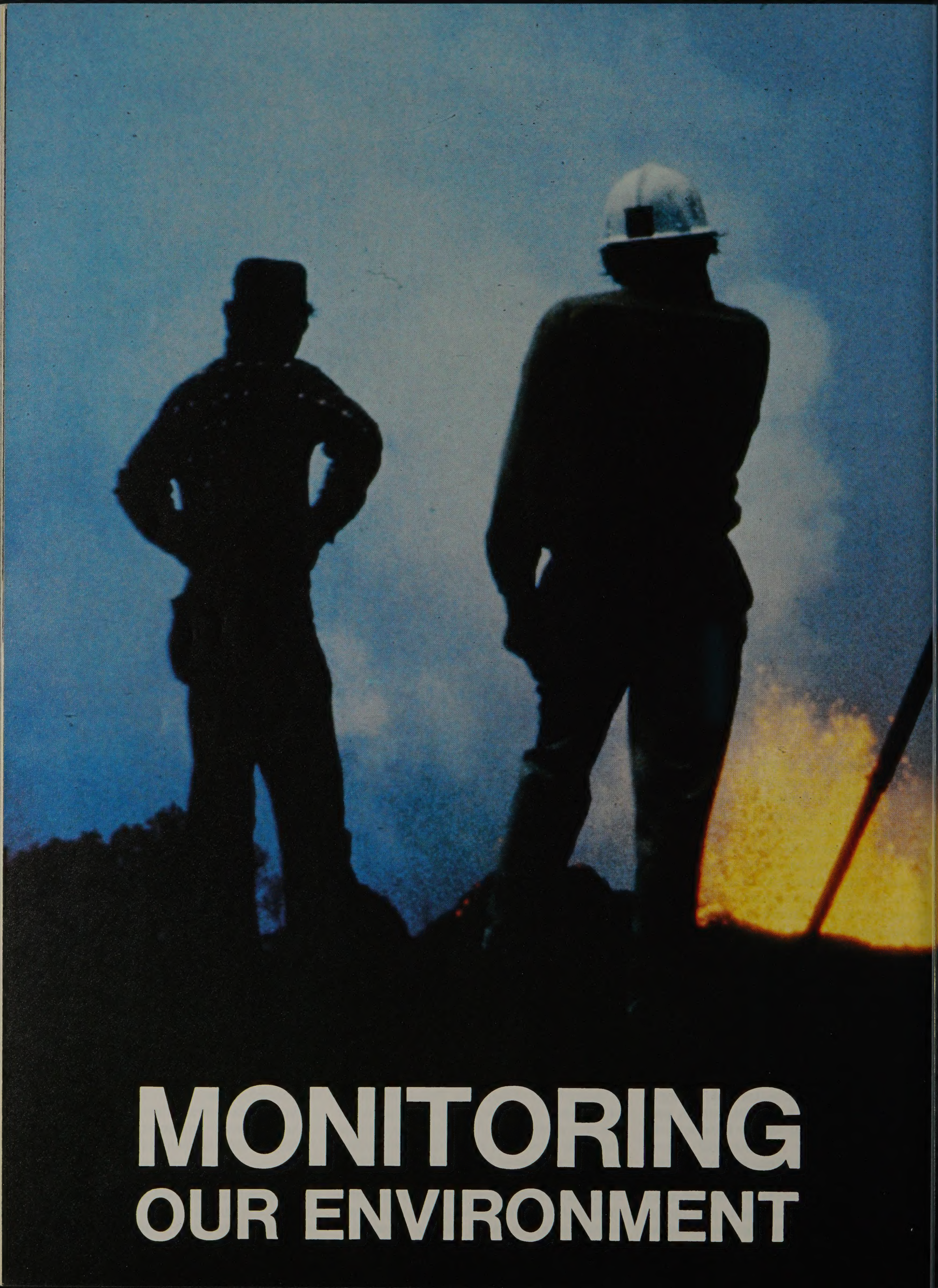
In view of the growing interest in water reuse and with the technology available through the Saline Water Conversion program, the Office of Water Research and Technology sought authorization and an appropriation to initiate a new research and development effort to advance the concept of water reuse. These were approved by the Office of Management and Budget and by Congress, so the first *national* research and development program devoted to water reuse was started in Fiscal Year 1977.

The Water Reuse Program is conceived as an effort to encourage the reuse of water as a means of augmenting existing supplies. The direct "pipe-to-pipe" reuse of waste waters for drinking purposes is not a goal at this time, since many questions on health effects cannot be answered. However, many situations are known to exist in which water of less than potable quality can be used and, such indirect applications as irrigation and groundwater recharge may help provide the data and acceptability required to make potable reuse a reality.

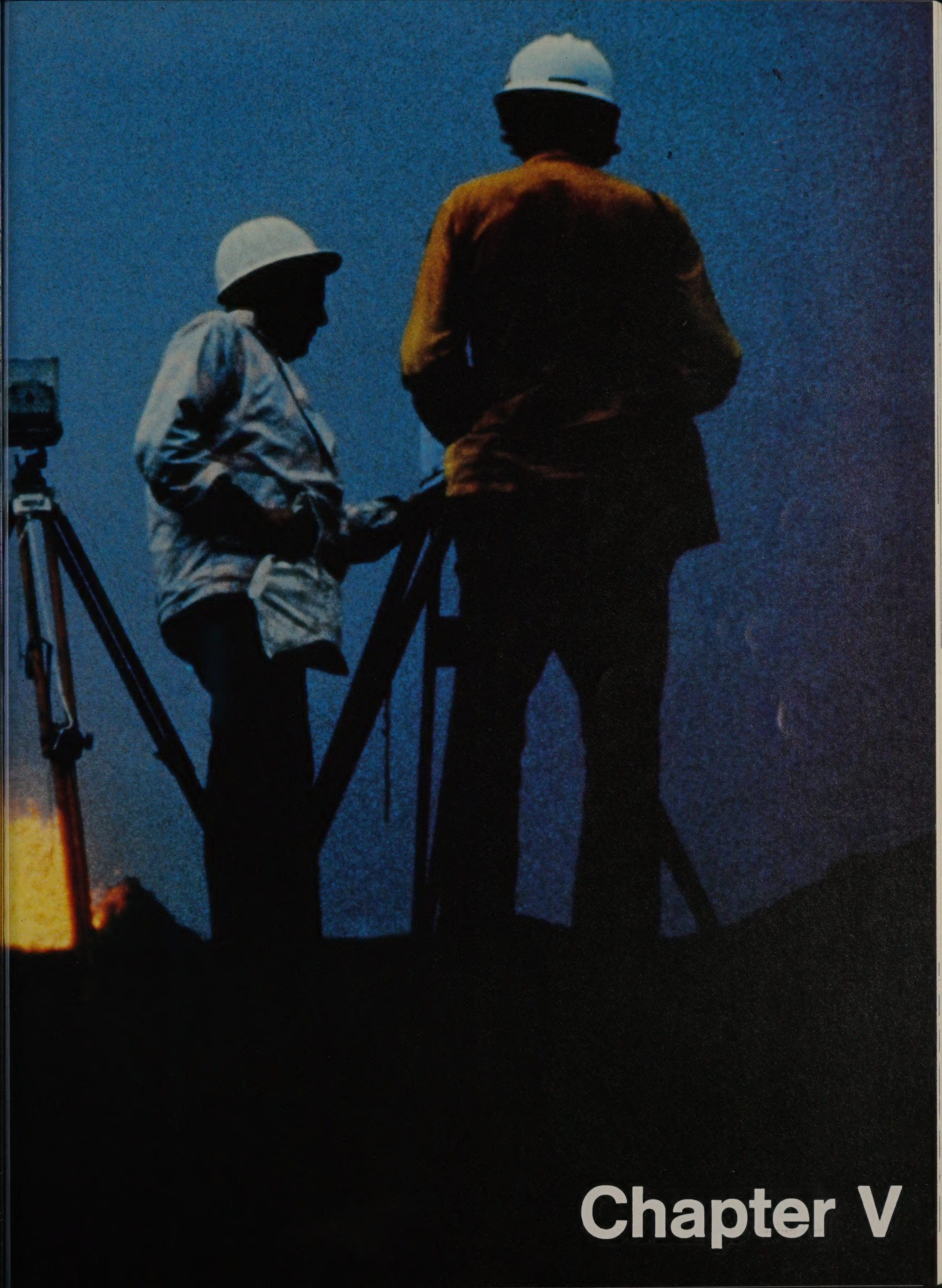
Among the more significant efforts funded in the initial year of the reuse activity makes OWRT a participant in the water reuse project underway in the Orange County Water District at Fountain Valley, California. This project, popularly known as Water Factory 21, includes a reverse osmosis plant built to provide five million gallons per day of high quality water from sewage plant effluent. This water is injected into an underlying aquifer to act as a barrier between encroaching sea water and the fresh groundwater supply. Since it is generally understood that some of this water will eventually enter the drinking water supply for the locality, a program has been established to accomplish the following:

1. Determine the kinds and concentrations of organics in reclaimed waste waters and their variations with time.
2. Evaluate the fate of organics in the reclaimed water after underground injection.
3. Compare carbon adsorption and reverse osmosis for removal of organics.
4. Develop more routine analytical procedures for analysis for polynuclear aromatic hydrocarbons.
5. Develop and use tests utilizing the mutagenic effect for screening potential carcinogens that may be found in reclaimed water.
6. Evaluate the effectiveness of advanced waste treatment techniques for removal of viruses and other organisms.

Indicative of the high regional interest in this concept is the fact that almost two-thirds of the cost of this three-year study will be borne by non-Federal sponsors.



MONITORING
OUR ENVIRONMENT



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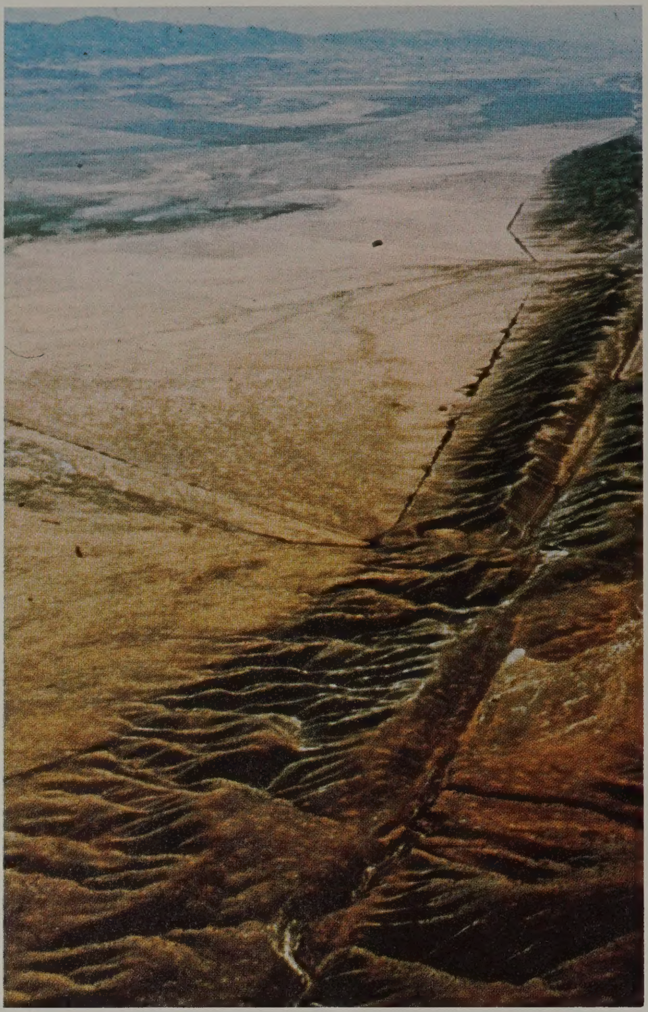


State of the Art

NATURAL HAZARDS WARNING

Earthquake Predictions... Volcanic Eruptions, Lava and Mudslides... Rockslides and other Natural Hazards

By Robert Matthews

Scientists of the United States Geological Survey discuss the "state of the art" of monitoring and predicting potential catastrophic disasters.

What early warning system do we have?

How would the American people respond?

The Guatemalan earthquake of February 4, 1976, the Chinese earthquake of July 27 and 28, 1976, and other recent geologic catastrophes causing loss of life and injuries numbering over a million, directly focused the attention of peoples of the world on problems of geologic-related hazards. These catastrophic events occurred thousands of miles from the United States, however, and the tremendous impact of deaths, injuries, and damage to the environment were soon forgotten here.

If we look further into the consequences of geologic-related hazards such as volcanic eruptions, landslides and mudslides, floods, tsunamis (sea waves generated by earthquakes), subsidence, and others, some staggering

Devastating earthquakes may occur along the San Andreas fault in California (far left). The fault underlies this San Francisco landslide.

(Right page). Familiar natural hazards include landslides in southern California and volcanoes in Hawaii.

losses of life and property become apparent—approximately 250,000 lives and $40 billion per year worldwide.

Fortunately for Americans, the costs in lives and property of such events here in the U.S. have not been comparable in scale to those in many other areas. In part this is a result of the distribution and density of our population. Quite probably, we simply have been lucky. Major earthquake events in U.S. have occurred either in areas of low population and development, or at a time when human activity was low (non-rush hours or on weekends).

Some of the most powerful earthquakes in the U.S. occurred in the Mississippi Valley area near New Madrid, Missouri, in 1811 and 1812. The total population of this large area at that time was less than the population of many major cities of the U.S. If an event of that magnitude were to occur today, and that possibility does exist, many thousands of lives would be lost and billions of dollars of damage to property would occur. The San Francisco earthquake of 1906 killed 700 people and caused $500 million dollars of damage. Today, such an earthquake during rush hours might kill 10,000 or more people, injure 40,000 and cause $5-to-50 billion of damage. A similar earthquake in the Los Angeles area might kill 20,000 people and injure 80,000 more.

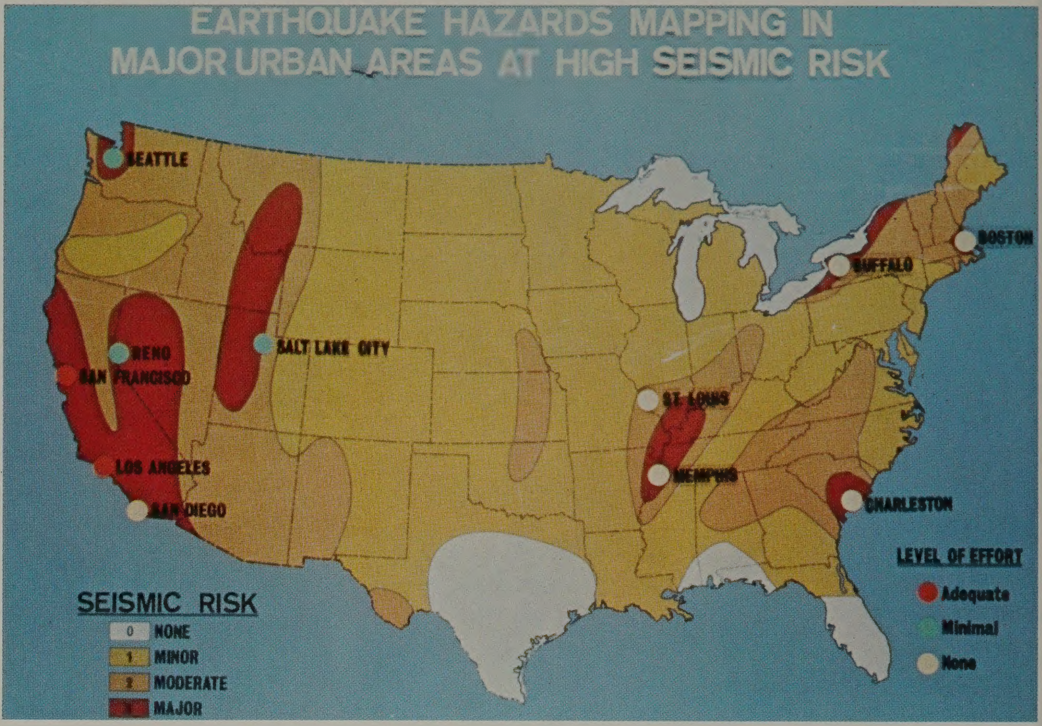
In view of the enormity of such potential losses from earthquakes and other geologic-related hazards, the U.S. Geological Survey has inaugurated a program to develop hazard warnings, measures for preparedness and mitigation, and technical assistance. This program is directed towards developing public awareness of earthquake and other geologic-related hazards and strongly encouraging long-range mitigation measures.

Under this program, the Survey has developed policies and procedures for reporting potential and actual geologic-related hazards, evaluating and transmitting pertinent information on the hazardous conditions to the responsible or affected governmental units, and making available technical information and assistance to states and local communities affected. Such assistance obviously must be limited because of potentially excessive costs.

A hazardous warning service is necessary to issue timely and effective warnings of geologic-related hazards to units of Federal, State, and local governments responsible for public health, safety, welfare, and facilities, and to the general public. Three types of hazard notices have been developed by the Survey for communicating with State and local governments and Federal agencies that may be affected by hazardous geologic conditions. A procedure for determining if a hazard notice should be issued has been carefully worked out. Once a potentially hazardous geologic condition is reported by USGS personnel, the Director will convene a panel of experts to evaluate the report. Upon the advice of the panel, the Director may determine that no hazardous condition exists or that there is insufficient information to indicate that a hazard exists. Or he may take one of three progressively serious preparation actions, ranging from issuance of a *Notice Of Potential Hazard*, through the initiation of a *Hazard Watch,* to the actual issuance of a *Hazard Warning* (prediction).

Each hazard notice that is issued will be accompanied by the documentation defining the potential hazard and by a summary evaluation of the evidence by the panel experts.

Three official Notices of Potential Hazard have been issued by the USGS to date: (1) A potential rockfall hazard in Montana, which poses the threat of a huge rock mass falling downslope toward several homes; (2) a potentially active fault in an urban area of southern California, which could directly affect existing and planned structures; and (3) differential land subsidence (sinking of the land) associated with a prehistoric fault in Nevada, which might result in damage to buildings, roads, and pipelines. A copy of the Notice of Potential Hazard was sent to each of the governmental units concerned with hazards problems in the affected area.



One Hazard Watch currently underway involves the monitoring of the Palmdale bulge, an area of seismic activity and crustal uplift in southern California. Geophysical equipment is being operated to monitor changes in tilt of the ground; the exact location, number and magnitude of seismic shocks; the magnetic and gravity conditions of the area; and minute changes in the elevation of benchmarks. Analyses of these different kinds of geophysical and topographic data may enable the determination of whether a hazardous event will occur, as well as the time, the magnitude, and the specific location of the event.

A different type of Hazard Watch is underway in the Island of Hawaii, where the volcano Mauna Loa has been relatively quiet for more than 25 years. The USGS, in addition to numerous arrays of geophysical instruments, installed a special geophysical monitoring system in 1967 using a very precise laser beam distance-measuring instrument. In April 1974, monitoring instruments detected an increase in seismic activity (small earthquake) and an inflation or swelling of the volcano. A notice was sent to State and county officials and on July 5, 1975, the volcano erupted. The activity subsided after a short period of eruption, but continued monitoring has detected some unusual behavior patterns, and the Hazard Watch condition is in operation with future eruptions expected. A Hazard Watch of Kilauea volcano on Hawaii has resulted in accurate predictions of eruptions.

It is quite likely that if detailed geologic and geophysical studies are undertaken for other volcanoes such as those of the Cascade Range in California, Oregon, and Washington, and of the Aleutian chain of Alaska, the capability for predicting eruptions in those areas could be developed. Mounts Rainier, Shasta, St. Helens, Baker, and Hood in the Cascade Range are all large volcanoes that are presently dormant. All, however, have experienced volcanic activity in the last 12,000 years. As recently as 1916, Mt. Lassen in California erupted.

In 1975, Mt. Baker exhibited increased steam eruptions and fumaroles (gas and steam vents), and is currently being monitored by the USGS with various geophysical equipment. A large increase in emission of steam and ejection of rock material at Mt. Baker may indeed be a forewarning of a more severe and potentially catastrophic eruption of volcanic material, with possible development of mudslides and rock avalanches. During the summer of 1975, in response to the potential effects of the increased thermal activity on Mt. Baker, authorities responsible for public facilities at Boulder Creek and Baker Lake closed off the area to public use and maintained Baker Lake reservoir below full pool level as insurance against possible overtopping of the dam that might be caused by major mudslides or avalanches into the reservoir. The potential hazard and the uncertainties of future activity of Mt. Baker necessitate continued observance and monitoring.

What does the sudden increase in thermal activity on Mt. Baker indicate? What does the monitoring from 1975 to the present indicate? These are the questions the USGS is trying to answer in order to be able to issue timely and effective warnings.

When a Hazard Warning (prediction) is issued for a disastrous event that may be imminent, public officials will be notified immediately by telephone. When appropriate, the information will also be communicated to the public through existing Federal communication facilities such as the Department of Commerce Weather Radio System and the Department of Defense National Warning System. No warning or prediction notices have been issued to date. Such a notice requires detailed specific information on the time, location, and magnitude of the hazardous event.

Prediction and warning for some types of natural hazards differ greatly from prediction and warning for most geologic-related hazards. One can see a storm approaching, and in some cases hurricanes, typhoons, or even floods, but there are really no obvious pre-warnings (recognized to date, except with sophisticated equipment) of earthquakes, volcanic eruptions and mudslides.

The continuing effort of the USGS in assessing potential geologic-related hazards is directed towards development of nationwide methods, procedures, and techniques to notify State and local government agencies and the public of real and potential hazards.

All notices issued by the USGS will include an offer to consult with any reviewers that the Governor or Governors of the affected States or Trust Territories may wish to appoint, and to provide technical assistance within areas of expertise of the USGS.

Research on earthquakes, landslides, volcanic eruptions, subsidence, glacier-related hazards, and other geologic catastrophes has not reached the state where predictions can be made with the very high degree of precision and confidence that is required. Some predictions have been made of local, well-understood, extensively studied hazards, but research must be continued to develop accurate, dependable techniques for predictions of earthquakes, volcanic eruptions, landslides, and other potentially catastrophic events.

State of the Art

EARTHQUAKE PREDICTION

By Dr. Robert M. Hamilton

Quake damage at San Fernando.

Earthquake prediction, a controversial and elusive goal of scientists, has long been a lively topic of after-dinner conversation. The fascination with earthquakes derives mainly from their mysterious nature and awesome power and their capability of striking without warning to wreak disaster.

The potential for disaster increases with the growth of population and development in earthquake prone areas.

Historical accounts are rich with reports of strange events before earthquakes: dogs howling, strange lights in the night sky, weird sounds, withdrawal of the sea from a harbor, to name a few. The significance of strange animal behavior has generally been discounted, and the reports of lights and sounds have been difficult to document. But many of the other observed phenomena have been sufficiently impressive to hold out the hope to scientists that earthquakes can be predicted.

Many of the reports of earthquake precursors have come from Japan. A particularly impressive anomaly was observed for the magnitude 7.5 (Richter Scale) earthquake that caused heavy damage in the city of Niigata in 1964, when level surveys and a tide-gage station revealed anomalous land uplift beginning 10 years before the shock. Reports such as this proved sufficiently encouraging to lead Japan in 1965 to establish a formal program to predict earthquakes.

A serious attempt to predict earthquakes has also been underway for some time in the Soviet Union. Near the village of Garm in the seismically active Republic of Tadzhikistan, scientists have been working on earthquake prediction for over 25 years. The fruits of these labors were revealed in the late 1960s, when Soviet scientists reported that prior to some earthquakes the speed with which vibrations or waves travel through rocks deep in the Earth shows a distinctive, troughlike variation. Up to then, seismic wave velocity had been regarded as constant. This startling discovery opens a new realm of scientific investigation.

Soviet scientists also reported a variety of other phenomena as earthquake precursors. The amount of radon gas in well water showed an increase before the earthquake at Tashkent in 1966. The electrical resistivity of the Earth behaved unusually before earthquakes near Garm and in Kamchatka. Migration of centers of seismic activity and reorientation of earthquake-causing rock stress were also observed. Taken together, these findings presented an impressive case that earthquakes indeed have precursors.

United States earthquake prediction was spurred by the great Alaska shock of 1964, which, at magnitude 8.5, is the largest U.S. shock ever observed. The magnitude 6.5 earthquake at San Fernando, California, in 1971 sharpened the interest in the prediction challenge. Soon after the shock, the U.S. Geological Survey's Earthquake Hazards Reduction program, which supports most of the American research on earthquake prediction, was expanded.

U.S. scientists have reported earthquake precursors similar to those reported by foreign scientists. In hindsight, it appears that the magnitude 6.5 earthquake near San Fernando in 1971 was preceded by variations in seismic wave as was a smaller quake of magnitude 5.0 in central California in 1972. In the Adirondack Mountains region of New York State, a small earthquake was successfully forecast on this basis in 1973. The size of these "velocity anomalies," however, has not been much above background variations in velocity, and some earthquakes in well-instrumented regions have shown no anomalies.

Other phenomena, however, have proved more encouraging. An electrical resistivity anomaly in the earth's crust was observed before a magnitude 3.9 earthquake struck in central California in 1973. But the most exciting new results came in November 1974, involving USGS operation of a dense seismic network as part of an experimental earthquake prediction system. Strong precursors to the shock were observed in the earth's magnetic field, the first such anomaly recorded anywhere. These changes in the magnetic field were accompanied by tilting of the land surface. Also, the lengths of well-measured survey lines were changed. Such a variety of precursory phenomena had not been previously observed to be associated with a single earthquake.

Thus, by 1974, the Soviet Union, Japan, and the United States had taken on earthquake prediction as a national goal and had found evidence that earthquakes have precursors. At that time, the Chinese effort in earthquake prediction was virtually unknown in other countries.

Chinese earthquake specialists came to the United States in the spring of 1974, however, and although they gave little substantive information on their program, they dropped enough hints to alert U.S. scientists that they had some surpries in store when the U.S. delegation visited China in October of 1974.

What the delegation found was a well-organized, large-scale research effort specifically aimed at earthquake prediction. This program began soon after two very destructive earthquakes hit China's Hopeh Province in 1966. Roughly 10,000 people, including several hundred scientists, are working in China to predict earthquakes by means of a wide variety of instrument systems, including some of the best in use anywhere in the world today. These specialists are joined by uncounted thousands of amateur workers who contribute to the prediction effort. Almost every technique that has ever been suggested as a basis for prediction is being studied to some degree. Numerous precursors have been observed, ranging from reports of unusual animal behavior to well-documented geophysical anomalies. About 10 earthquakes have been successfully predicted, and warnings have been issued. *It is readily acknowledged, however, that many predictions have not been followed by earthquakes.*

Fourth Avenue, Anchorage, in 1964.

In their quest for earthquake prediction, scientists are learning much about the forces that generate them. Above: fishing craft, automobiles and trucks were part of the wreckage left by the 1964 Alaska earthquake.

Laboratory studies show that earthquake precursors should exist, and numerous field observations seem to confirm that they are observable. But we confront two important scientific questions. Do all earthquakes have precursors? And are precursors sufficiently regular or uniform in nature to be reliable? These questions can be answered only through careful observations and continued research.

As is the case with the most new technological developments, progress can be a mixed blessing. There is no doubt that earthquake predictions can save lives. But, in the finely balanced socio-economic structure of the United States, a prediction can also cause serious problems. One can imagine that prediction of a shock near a major city could lead to, among other things, a drop in tourism, nonrenewal of earthquake insurance policies, fleeing of the area by the panic stricken, and convergence on the area by the thrill seekers. Failure of the earthquake to occur could result in recriminations, law suits, and loss of faith in the scientists who made the prediction. Convincing people that they had just experienced a "near miss" with an earthquake would not be as simple as convincing them that they had barely avoided a hurricane that had veered offshore.

It is almost certain that some incorrect predictions will be made while scientists gain experience. With adequate preparation, however, adverse public response can be minimized. The time span over which predictions are most susceptible to error could be reduced by intensifying research efforts.

Handled in a proper way, predictions can provide enormous benefits. Tens of thousands of lives were saved in 1971 because the level of the Lower Van Norman Reservoir had been lowered before the earthquake that struck at San Fernando caused near collapse of the dam. Although the action was based on general concern for the dam rather than than on an earthquake prediction, the lesson is clear. Many critical facilities are of necessity located in regions that will experience strong earthquakes.

A warning could avert serious consequences resulting from damage to pipelines, storage tanks, and nuclear reactors. Many substandard buildings in use today would probably collapse in an earthquake.

Evacuation of cities, though often mentioned as a response to a prediction, would not be a necessary or wise course in the United States under almost any circumstances that may be envisioned. In California, where prediction may first become a reality, most residences are of wooden-frame construction and stand up well in earthquakes. Therefore, most people would be relatively safe in their homes during a tremor. Certain hazardous buildings should be evacuated, but these could be specifically identified. Thus, the vision of a mass of people streaming out of an earthquake-threatened city need not become a reality. Dissemination of information and advice to the public can avert panic situations.

Much remains to be accomplished before a solid basis for earthquake prediction can be established and before such prediction becomes as useful as weather forecasting. Instruments are deployed in only a few areas, the consistency of precursors has not been established, and a physical model to explain precursors remains to be confirmed. The transition to a reliable prediction capability will not be sudden. Even in the areas that are now under study, the development phase may stretch over the next decade. In the meantime, we can expect to see numerous scientific predictions based on fragmentary data. Procedures have been established to assure that these data receive thoughtful and responsible consideration.

In the quest for earthquake prediction, scientists are learning much about the nature of earthquake generation. The success with which earthquakes can be predicted remains to be determined, and many problems in the use of predictions remain to be solved. Progress toward prediction has been rapid in recent years, and the future is bright.

State of the Art

VOLCANO VIGIL

By Dr. Robert I. Tilling

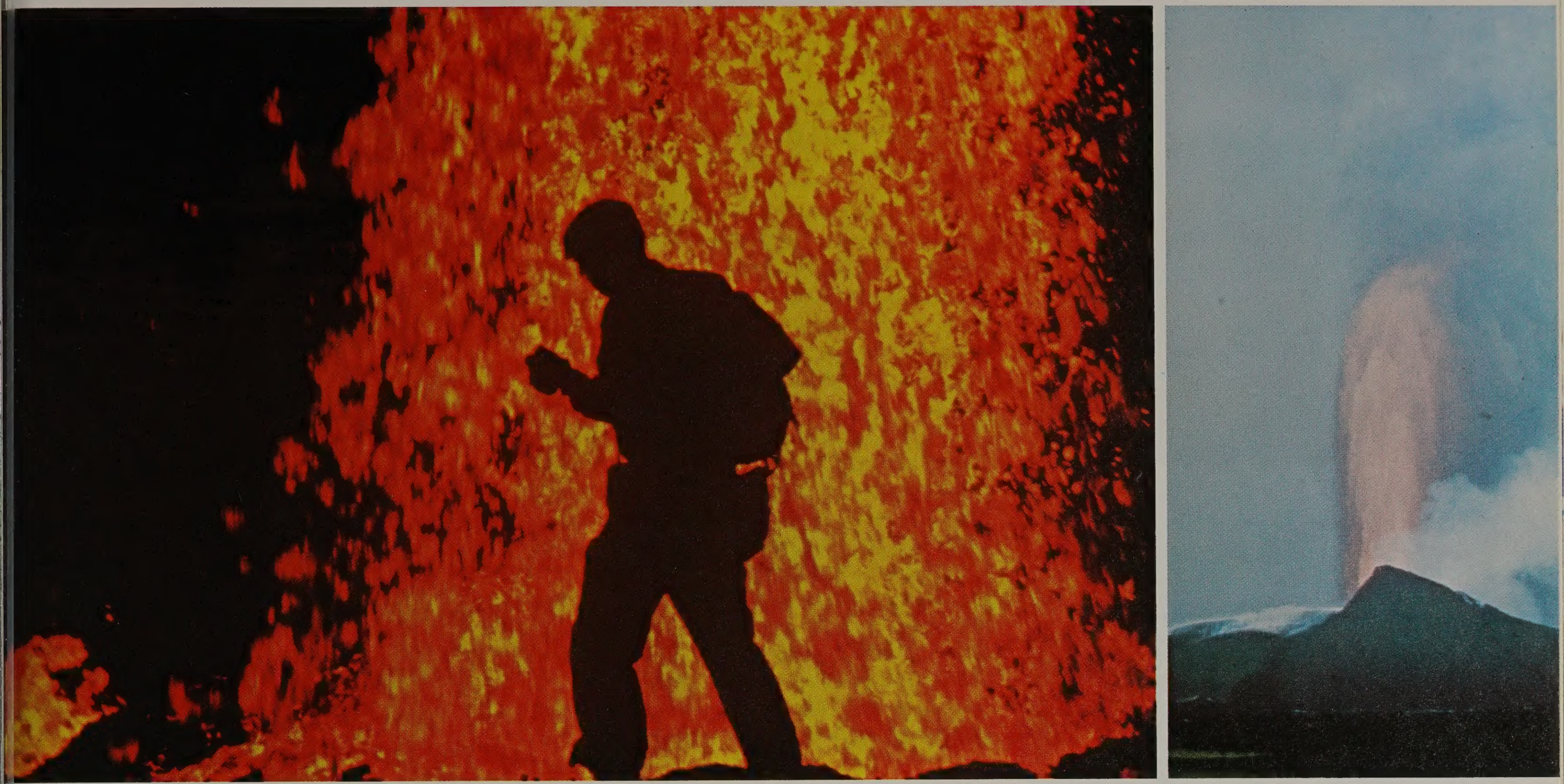
One of the most awesomely beautiful displays of natural energy is an erupting volcano, belching fume and ash thousands of meters into the atmosphere and pouring out red-hot molten lava in fountains and streams.

Countless eruptions in the geologic past have produced volcanic rocks that form much of the earth's present surface. The gradual disintegration of these rocks has yielded some of the richest farmlands in the world, and these fertile soils play a significant role in sustaining our large and growing populations. Were it not for volcanic activity, the Hawaiian Islands—with their sugar cane and pineapple fields and magnificent landscapes and seascapes—would not exist to support their residents and to charm their visitors. Yet, the actual eruptive processes are catastrophic and can claim life and property.

Eruptions of the volcanoes that dot the margins of the moving rigid plates of the earth's crust characteristically are violently explosive. For example, in 1902 a single explosive eruption of Mount Pelee Island of Martinique in the Lesser Antilles, virtually destroyed the entire city of St. Pierre, killing some 30,000 persons. On the other hand, eruptions of the Hawaiian volcanoes generally are nonexplosive and more benign, posing a threat to property, but rarely to life. For example, lava flows of the 1960 eruption of Kilauea Volcano burned the small village of Kapoho on the eastern tip of the island of Hawaii. Not a single person was injured or killed, however, because warning signals of impending eruptive activity were detected in time to permit safe evacuation of Kapoho residents.

There are presently about 500 known active volcanoes on the earth, not counting those that lie beneath the sea. Scientists have estimated that at least 200,000 persons have lost their lives as a result of volcanic eruptions during the last 500 years. Little wonder then that people living in the shadow of active or dormant volcanoes have feared eruptive outbreaks in times past and present.

Centuries ago, the Romans attributed volcanic and related phenomena (including earthquakes) mainly to the movement of wind, imprisoned inside the earth,


Author Bob Tilling is silhouetted against flames of active volcano as he conducts his scientific measurements. A fiery fountain of lava (right) rises from Kilauea volcano, Hawaii.

rushing violently out to the surface. The Polynesians believed volcanic activity to be caused by the beautiful but wrathful Pele, Goddess of Volcanoes, whenever she was angered by actions of other deities or of mortals. Today, scientists know that volcanic eruptions occur when buoyant magma (molten rock) that formed deep in the earth, ascends and ultimately is ejected upon release of gas pressure. With precise, sophisticated instruments and refined data analysis, it is now possible to track the subsurface movements of magma by monitoring earthquakes and ground changes.

Although the present state of knowledge does not permit the prediction of the exact time and place of eruptions, we can detect departures from usual behavior that augur impending activity. Systematic monitoring studies are conducted only on a few active volcanoes—those in Hawaii, and some in Italy, Japan, New Zealand, and Kamchatka (U.S.S.R.). Most of the active volcanoes are not monitored, little understood, and extremely hazardous if in populated regions.

Monitoring Techniques

Most of the commonly used monitoring methods were largely pioneered by the *Hawaiian Volcano Observatory,* established in 1912 by Massachusetts Institute of Technology, and operated continuously by Geological Survey since 1948. The many years of continuous observations of Kilauea and Mauna Loa, two of the world's most active volcanoes, have fostered fundamental developments in instrumentation and measurement techniques, which are increasingly used in the study of other active volcanoes the world over.

The volcanic plumbing and reservoir system beneath Kilauea can be pictured as a balloon buried under thin layers of sand and plaster. In reservoir (analogous to air filling a balloon), the internal pressure increases, and the sand-plaster surface layers are pushed upward and outward in order to accommodate the swelling or inflation. The net effects of such inflation include: the steepening of slope of the volcano's surface; increase in horizontal and vertical distances between points on the surface; and in places, the fracturing of the sand-plaster layers stretched beyond the breaking point. Such rupturing of materials adjusting to magma-movement pressures results in earthquakes. A shrinking or rapidly draining reservoir to feed surface eruptions (analogous to deflating or popping the balloon) would produce the opposite effects; flattening of slopes, reduction in distances between surface points, and decrease in earthquake frequency.

Changes in slope in a real volcano can be measured precisely by various electronic-mechanical "tiltmeters" or field tilt surveying techniques, which can detect the change in slope of a kilometer-long board if raised by the thickness of a dime placed under one end.

Similarly, very small changes in horizontal and vertical distances can also be measured by an electronic distance measuring instrument that uses a laser beam. Such changes can be easily detected to a precision of only a few parts per million. The notion of one part per million can be dramatized in terms of a very dry martini—1 drop of vermouth per 16 gallons of gin.

The frequency, location, and magnitude of earthquakes generated by magma movement can be easily and accurately determined by data from a properly designed seismic network. For example, the Hawaiian Volcano Observatory has recently expanded its seismic networks to 45 stations to better monitor the earthquake activity of Kilauea and Mauna Loa on a round-the-clock basis.

The proper analysis of monitoring data requires a basic understanding of the prehistoric eruptive record and behavior of a volcano that can only be reconstructed from regional geophysical and geological studies, and dating and geochemical investigations. Such glimpses into a volcano's prehistoric past are critically important.

Recent Case Studies

Investigations carried out as part of the USGS Volcano Hazards Program provide case studies of monitoring two of the world's most active and best understood volcanoes, Mauna Loa and Kilauea on the "Big Island" of Hawaii.

Mauna Loa last erupted July 5-6, 1975, having been inactive since June, 1950. The first hint of change leading up to the 1975 eruption was a marked increase in the number of earthquakes beginning more than a year before. Inflation or swelling of the summit was detected during the annual "laser beam" remeasurement of horizontal distances across the summit crater. The 1974 set of measurements showed the first significant increases in the horizontal distances of the lines across the summit crater since the inception of the precise distance monitoring program in 1967. The USGS immediately alerted Hawaii officials and the general public to the possible reawakening of Mauna Loa from its long slumber.

During the next 12 months, both the ground-deformation and seismic networks on Mauna Loa were expanded. Intensified monitoring showed that numbers of earthquakes and the rate of summit inflation increased steadily, reaching a crescendo during the summit eruption that began on July 5 of 1975. The exact timing of the eruption could not be predicted, even though all premonitory indicators pointed toward an eruption any day.

Although the earthquake frequency tapered off sharply in the weeks following the July eruption, swelling of the summit resumed, indicating continuing accumulation of magma in Mauna Loa's summit reservoir. Measurements made on six separate occasions over a period of a year and half following the eruption all demonstrated continued swelling. From analysis of the written records of the past historic eruptive behavior and the fact that both the earthquakes and swelling had extended out along the northeast rift, Observatory scientists suggested that a flank eruption on the northeast rift was likely sometime before the summer of 1978, if Mauna Loa were to behave as it has for the past 200 years.

Newly observed changes in the geodimeter lines in July 1977, however, suggest that Mauna Loa may be departing from previous behavior, and the timetable for the predicted eruption may have to be revised. Inflation of Mauna Loa Volcano has slowed. The northeast-rift zone has contracted slightly, and there has been little seismicity of significance in recent months. According to Survey scientists, the volcano is not shrinking or deflating. The magma that accumulated in the summit region over a period of more than three years (since April 1974) has not drained away. Thus the potential for an eruption is still very much present.

These recent developments show that the relatively limited time span of intensive monitoring (three years) and the short historic record (about 200 years) are simply inadequate to establish statistically reliable probabilities for the exact time and place of the next eruption, even though Mauna Loa is still "primed" for action.

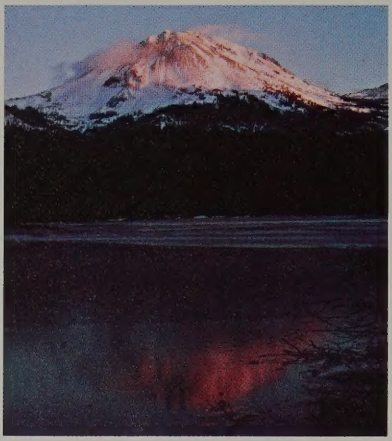
While Kilauea has been closely monitored for a longer period than Mauna Loa, the necessary state of knowledge for prediction of eruptive activity has not been achieved. But there have been some notable successes. For example, in the early 1970's several eruptions were predicted with sufficient certainty four to eight hours in advance, so that USGS scientists could advise officials of Hawaii Volcanoes National Park to evacuate certain sections. The Park Rangers were able to safely clear park visitors from the actual outbreak areas in ample time. But there also have been false alarms.

In the fall of 1976, increased steaming and dying of the forest near Heiheiahulu on Kilauea's lower east-rift zone to the north of Kalapana caused scientists to increase monitoring this area.

Because the east-rift zone of Kilauea has long been the locale of recurring lava flows and eruptive activity could pose a threat to downslope cultivated and populated areas, Hawaii County Civil Defense officials were advised of the unstable conditions. Hawaii residents were warned by a news bulletin issued on July 29, 1977. On September 13 lava fountains 25-30 meters high spurted along a five kilometer-long fissure only a few kilometers uprift (WSW) of the swollen Heiheiahulu area, following an intense earthquake flurry and abrupt deflation that began about 24 hours before. The eruption continued intermittently for the next 18 days along a restricted part of the fissure. The final and most voluminous phase of the activity produced a rapidly moving lava flow, which posed a potential threat to the village of Kalapana downslope. Unlike the nearby village of Kapoho destroyed during the 1960 eruption, Kalapana was spared, as the lava fountains stopped on October 1, and the 15 meter-high flow front slowly ground to a halt—only about 400 meters from the nearest dwellings.

Tremendous strides have been made in recent years in intensifying the monitoring of Mauna Loa and Kilauea as part of the Volcano Hazards Program, and understanding of the typically non-explosive, Hawaiian-type of volcanism has increased markedly. But reliable and specific prediction capability for eruptions in Hawaii still eludes science. The predictive capability is even poorer for explosive volcanoes, such as those in the Cascade Range of northwestern United States (Mount Rainier, Mount Hood, Mount Lassen), Alaska, and elsewhere around the Circum-Pacific "Ring of Fire."

The explosive Cascade volcanoes, which have erupted only rarely within recorded historic times, are potentially much more destructive and deadly than Hawaiian volcanoes. Should they erupt violently, large population centers in the northwest, such as Seattle and Portland, could be seriously threatened.



Mt. Lassen is still active.

MORE ON VOLCANOES

To provide reference terms for various phases of volcanic activity, scientists have classified volcanoes as *active, dormant,* or *extinct.*

An *active* volcano is one that is currently erupting or has erupted recently, and is expected to do so within the foreseeable future. Mauna Loa and Kilauea in Hawaii are *active* volcanoes. Mt. Lassen in California, which last erupted in 1914-21 is also considered *active.*

A *dormant* volcano is one that shows no current or recent history of eruptions, but could very well erupt at some time in the future. Mt. Rainier in Washington, which has shown no eruptive activity for nearly a century, fits this description.

Extinct volcanoes are those that have not erupted in recorded historic time and are not expected to do so in the future. Mt. Mazama in Oregon, in whose summit crater lies the incredibly blue national park attraction, Crater Lake, is considered to be *extinct.*

But there are problems in trying to put things neatly into boxes with no greater perspective than that afforded by man's written history or geologist's unravelling of the prehistoric record. New volcanoes are being born all the time—Surtsey, off Iceland, and Paricutin in Mexico both appeared within the last 35 years.

And Mt. Vesuvius, which destroyed Pompeii and Herculaneum in 79 A.D., was dormant so long that scholars of the Middle Ages regarded it as "peaceful." Now it is active again. Perhaps we can blame it all on the random tantrums of Vulcan, the Roman god of fire, from whose name we derive the word "volcano."—*Gerald Waindel.*

LANDSAT MONITORS THE ENVIRONMENT

By Ruth Y. Herbert

The use of remotely sensed data has become an efficient means of monitoring the environment, inventorying resources, mapping land use, and assessing disasters. For many years, U.S. Department of the Interior land managers and scientists had relied on conventional aerial photographs to acquire information more quickly and from a better vantage point than is possible from the ground. Since 1972, however, observations from satellites have provided a uniform, repetitive, and synoptic view of the Earth that was never before possible. This remote sensing system, named LANDSAT, provides for the first time a picture of how the Earth looks now to use as a frame of reference from which to measure changes and assess man's impact on the environment.

The primary LANDSAT sensor is a scanner, measuring the light reflected from various surfaces on Earth in several wavelengths of the spectrum. Since different surfaces reflect different amounts of light, the images produced from these measurements accurately represent different kinds of vegetation, soils, water, and cultural features. The digital form of the data permits extraction of information by computerized techniques.

The Geological Survey's Earth Resources Observation System (EROS) program demonstrates the latest applications of remote sensing technology in analyzing and processing data from satellites. The EROS Data Center in Sioux Falls, South Dakota, is the main facility for storing, reproducing, and distributing data from satellites and aircraft. It also offers training courses in interpreting the data.

Land Inventory

The Pacific Northwest Land Resources Inventory Demonstration Project is an example of a cooperative program using remotely sensed data to manage land resources. One hundred and fifty participants from 35 State and local agencies from Washington, Oregon, and Idaho, comprising the Pacific Northwest Regional Commission, were trained at the EROS Data Center at Sioux Falls and the Ames Research Center of the National Aeronautics and Space Administration at Moffett Field, California, to use this new technology to complete such activities as:

- An inventory of 15,500 square miles of forest in the State of Washington.
- Update of an inventory of 6,000 square miles of irrigated lands along the Snake River in Idaho including the area flooded by the failure of the Teton Dam.
- Survey of 26 Oregon counties to identify infestations of tansy ragwort, a weed toxic to livestock.
- A survey of 2,300 square miles of Oregon rangelands in a 5-year study of the summer habitat of the muledeer.
- A survey of urban change in six counties in the Portland, Oregon, area classified according to census tracts.
- An inventory of irrigated land in the Klamath River basin. To comply with an agreement with the State of California limiting the amount of water Oregon can take from the Klamath River, the extent of irrigated land is monitored on LANDSAT images acquired during the growing season. When water use approaches the limit, the State of Oregon imposes appropriate controls.

Water Management

The Bureau of Reclamation has acquired a computer system to develop an automated inventory of irrigated crops. LANDSAT data and aerial infrared photography are analyzed with techniques developed in the EROS Data Center's Data Analysis Laboratory.

The State of Nebraska uses computer-compatible tapes of LANDSAT images to inventory center-pivot irrigation systems, which are used on 80 percent of newly irrigated land in Nebraska. The inventory helps to predict crop yield and estimate seasonal depletion of ground water and provides information important to market surveys of agricultural equipment.

To determine the amount of water stored as snow and to forecast runoff in the Olympic and Cascade Mountains, Geological Survey scentists study successive satellite images and related ground measurements during the spring and summer months. This information is pertinent to the water supply and hydroelectric power in the Puget Sound area.

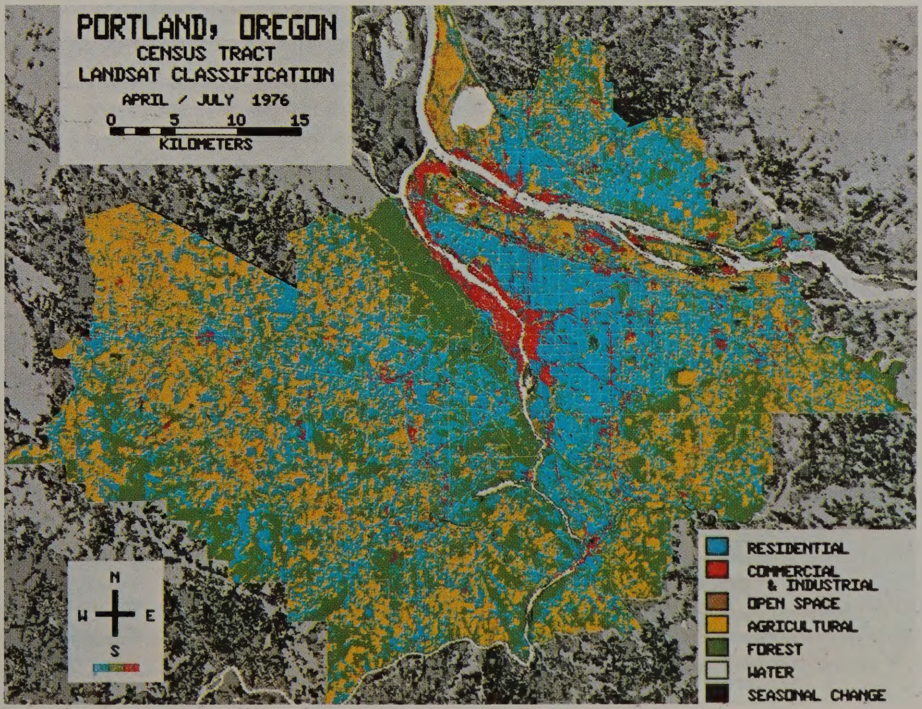
Images obtained by satellites and data relayed by satellites from remote locations are used to map the areal extent of snow and to estimate snowmelt for managing six reservoirs on the Salt and Verde Rivers in Arizona. Images obtained by LANDSAT and satellite-relayed data are also used for water management in the Florida Everglades, a nearly inaccessible area where water is difficult to measure because it does not flow in channels, and sufficiently accurate land-surface profiles do not exist.

Surface Mines

Fifteen maps of the New River basin in Tennessee were made from images obtained by LANDSAT to evaluate the impact of surface mining as a part of a 5-year energy development program.

Aerial photographs and satellite images and digitally analyzed LANDSAT

Landsat image of Portland, Oregon, metropolitan area shows classification by census tracts.



data are being used by the Bureau of Mines and the Geological Survey to monitor surface mining operations and stages of reclamation in four States and for preparing environmental impact statements.

The Mining Enforcement and Safety Administration is using aerial and satellite images to identify linear features that may be related to fault and fracture systems and associated mine roof failures and to locate and monitor leakage and movement of mine embankments. These efforts to identify potentially hazardous ground in mine areas have been applied to more than 100 sites in 26 States.

Coastal Areas

An oil seep in the Santa Barbara channel was detected on LANDSAT images that had been photo-optically enhanced or computer processed. Such a detection capability is the subject of experiments to develop a potential tool for coastal zone petroleum exploration.

The U.S. Fish and Wildlife Service used the facilities of the EROS Data Center's Data Analysis Laboratory to develop a National Wetlands Inventory by comparing ecosystem, physiographic region, and wetland class data obtained by satellites and aircraft.

As an example of mapping a temporal phenomenon, the Geological Survey is making a three-image mosaic of the Chesapeake Bay from data acquired by LANDSAT showing the maximum extent of ice.

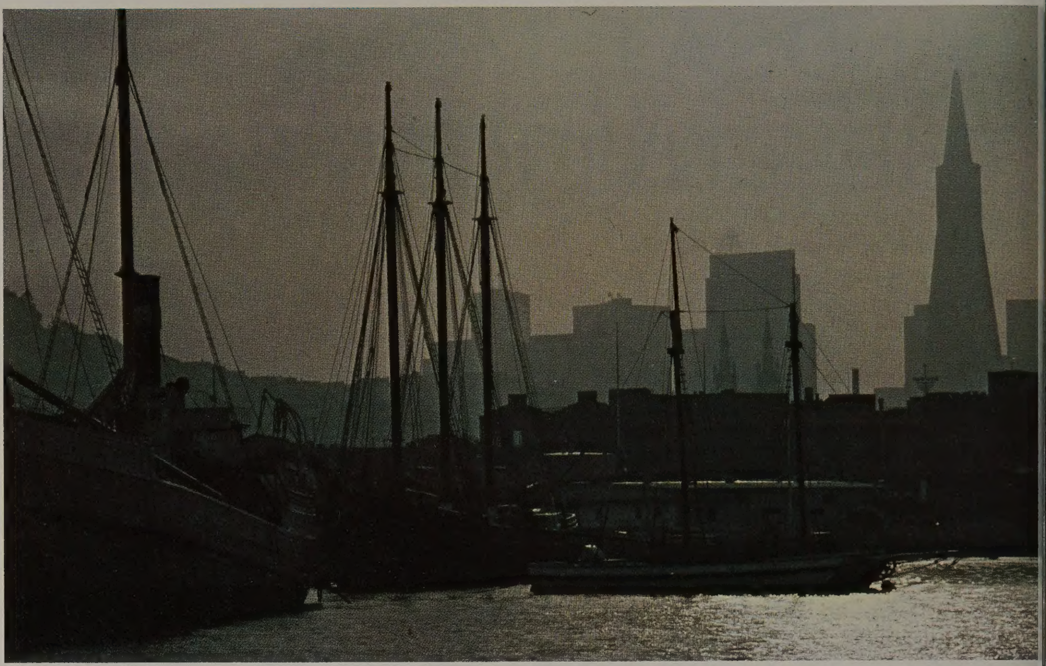
Alaska

Responsibility for the 37,000 square mile site of the National Petroleum Reserve of Alaska on Alaska's northern slope was transferrred this year to the Department of the Interior. To provide data with which to analyze the environmental impact of oil exploration, the Geological Survey made a digital classification of the land cover and vegetation on 10 LANDSAT images covering the area.

The Geophysical Institute of the University of Alaska made a mosaic of Alaska, at the request of the State, to match new geologic maps at a scale of 1:1,000,000. Geological Survey geologists are mapping linear features in Alaska to determine deformations of the Earth's crust that may indicate areas containing valuable minerals.

The Bureau of Land Management, NASA, and the EROS Data Center cooperated on a wildland inventory of the 3,100 square mile Denali test site in the Mount McKinley area of Alaska. During July and August of the dry summer of 1977 more than 500 fires burned about 3,100 square mile Denali test site in the region and the data employed to make the inventory were used to allocate fire protection measures to appropriate areas.

State of the Art



Area Planning for

SAN FRANCISCO

By Susan V. Lee

As the Nation's primary source of geological and hydrologic data, the U.S. Geological Survey provides much of the Earth-science information needed to manage and develop our land and water resources. Traditionally, however, these data have been presented in technical formats understandable most readily by other scientists.

In order to provide information that is directly and immediately usable by land resource planners, political decision-makers, developers, and the general public, the Geological Survey has conducted urban-area studies and prepared reports in formats and language designed for those user groups.

Areas selected for study all have rapidly expanding populations and potential for development that will place increasing demands on land and water resources. Earth-science information is especially necessary in such rapidly expanding urban areas to ensure that plans for and regulations governing future development are consistent with existing physical conditions and limitations.

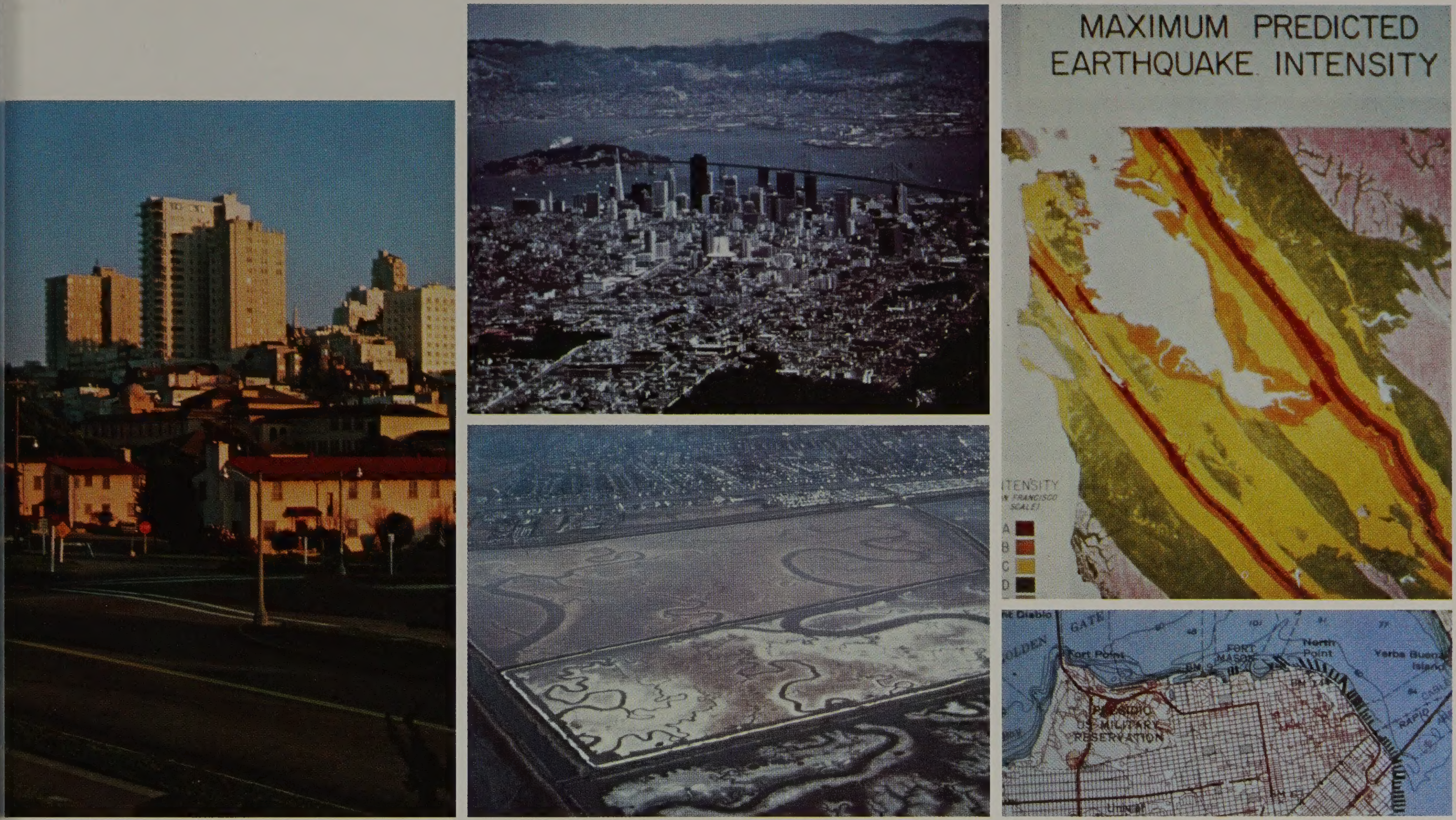
Planning is a rational process to coordinate design, construction and operation of public and private facilities, and to ensure that development is consistent with the economic and aesthetic goals of the community.

Scientific data and interpretations concerning natural resources, geologic hazards (such as earthquakes, landslides, and volcanoes), and information on existing urban development are necessary for comprehensive physical planning. Almost all individuals, firms, and institutions performing physical planning are potential users of Earth-science information such as that provided by the Geological Survey's urban area studies.

Bay Region Study

The San Francisco Bay Region Environmental and Resources Study was the Survey's first comprehensive urban area study. It was an experimental cooperative program begun in 1970 by the USGS and the U.S. Department of Housing and Urban Development. The goal was to identify and provide basic and interpreted Earth-science information needed in making land-use decisions for regional planning. The study resulted in the publication of about 100 Earth-science information products. Examples of the broad range of topics covered include: seismic hazards and land—use planning, landslide susceptibility, water and sewer service areas, effects of high water table on land use, mineral resources, and earthquake intensity maps.

The evaluation of the success of the study in providing information useful to the Bay community was made by conducting more than 200 interviews with planning personnel. The assessment was made to determine the extent of the use of the study's products in selected planning activities in the area's eight counties and 91 cities, which include


MAXIMUM PREDICTED EARTHQUAKE INTENSITY
INTENSITY (SAN FRANCISCO SCALE)
A
B
C
D
Mt Diablo
GOLDEN GATE
Fort Point
FORT MASON
North Point
Yerba Buena Island
PRESIDIO U.S. MILITARY RESERVATION

San Francisco waterfront (above), city residential skyline and aerial view looking toward Bay Bridge (right) with tidal flats. In its environmental and resource study, San Francisco gathered data upon which to manage land resources, make political decisions and structure future developments. One example is a map of earthquake intensities (right). Overlaid by a street map, planners can quickly spot areas of potential disaster.

almost 5 million people. The results: (1) all eight counties and three-fourths of the cities had planning staffs which had made frequent use of the study's products, and most had prepared planning documents that cite them; (2) the types of applications most often indicated by planners included geological hazards studies, seismic safety and public safety plan elements, general reference, and the preparation and review of environmental impact statements; and (3) more than 90 percent of the 87 Bay Region study products available at the time of the evaluation were used at least once.

Study Applications

One significant example of the application of data obtained by the study is demonstrated in the development of a seismic safety plan for Santa Clara County. The State of California requires that the general plan directing the physical development of each county include a "seismic safety element," which consists of the identification and appraisal of earthquake-related hazards.

Santa Clara County is one of the largest counties in the San Francisco Bay region and has the fastest growing population. The county includes parts of the active San Andreas and Hayward faults and many areas that are susceptible to landsliding. Because most of these hazardous areas are not yet intensively developed, it is especially important that they be clearly identified in plans governing land use.

The Santa Clara County seismic safety plan is based upon data published by the USGS and most of it resulted from the Bay Region study. Potential earthquake hazards such as ground shaking, surface fault displacement, landsliding, slow creep along faults, and tsunamis are shown on a composite map of the San Jose area, California. The relative hazards were divided into three zones that indicate varying requirements for geologic investigation. Other maps show the location of utilities, transportation routes, community facilities and urban development. When these other maps are overlaid on the composite hazards zone map, the combination clearly shows where potential hazard areas correspond with areas of existing and potential development.

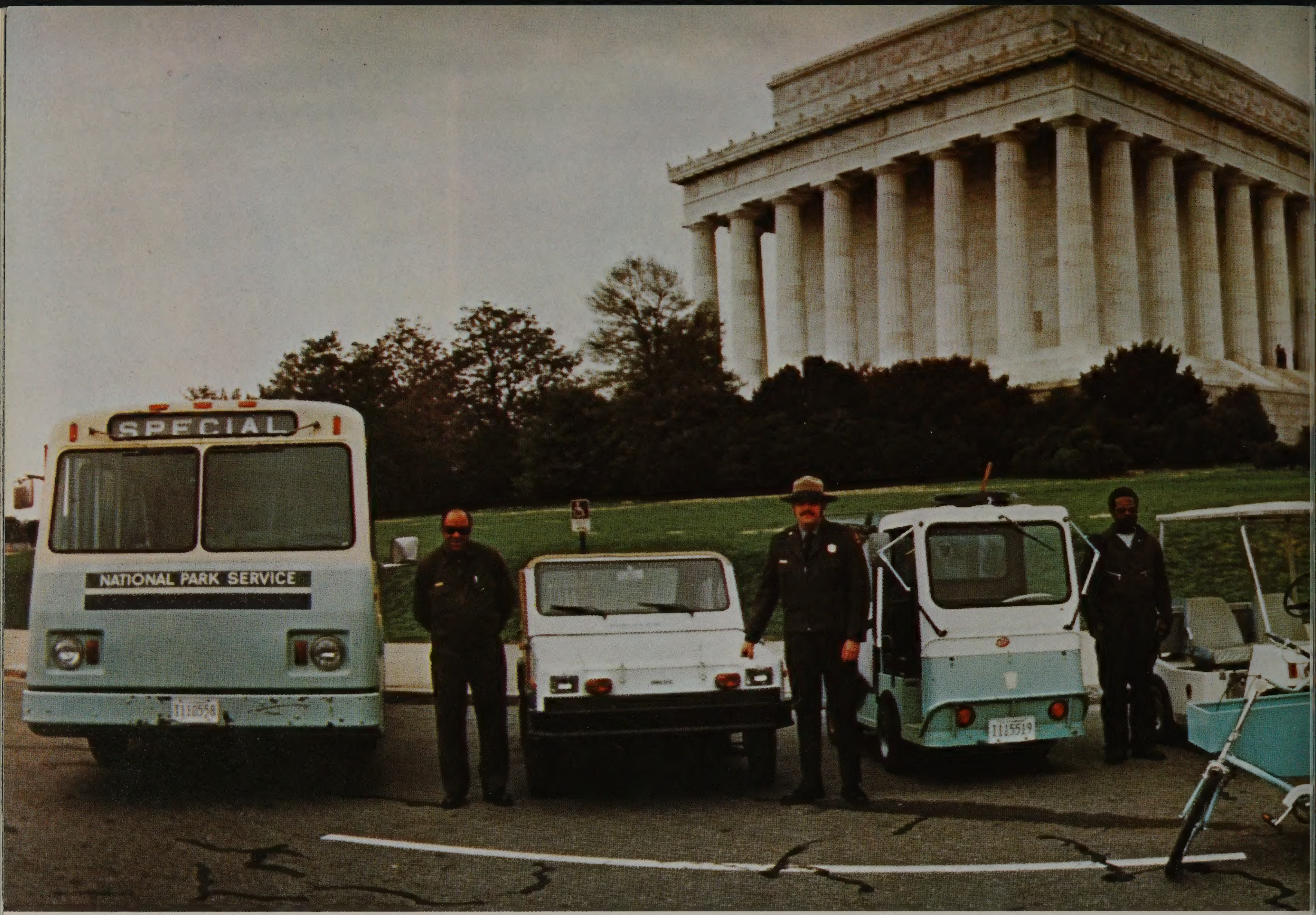
In 1974, the Santa Clara Board of Supervisors voted unanimously to amend the County Ordinance Code governing subdivision building. The Code now requires geologic investigations in the potentially hazardous areas. Approval of development in these hazardous areas is contingent on the developer's presentation of a plan to overcome or avoid the hazardous conditions identified in the geologic investigation. Thus, data from the San Francisco Bay Region Study have been incorporated into the legal structure of the county. By requiring special consideration of development in hazardous areas, this act will help reduce the effects of such *inevitable* natural occurrences as earthquakes and landslides.

Sonoma Inventory

Another example of an important application of the study's Earth—science data is an analysis of natural resources prepared by the Sonoma County Planning Department. This study, "Environmental Resources Management Element, Natural Resource Inventory" was prepared as part of the country's land-use, open-space, and conservation plans, all of which are required by State law.

The five natural resources considered in the study ore geology, soils, climate, hydrology, and vegetation. After data were compiled by the county, each natural resource was related to specific natural and human resource management goals and policies. For example, water-quality improvement is related to the preservation and restoration of ecological, recreational, and aesthetic benefits of the county's natural waterways.

The long-range goal of these Earth-science studies is to improve the quality and effectiveness of land- and water-resource planning and management nationwide. Urban area studies—those sponsored by the U.S. Geological Survey as well as studies sponsored by the individual State survey—provide examples for the development of similar projects across the country and illustrate the great potential that Earth-science information has in dealing with planning for areas where people live.



Interior's National Park Service has gained international recognition for its pioneer work in pollution-free electric vehicles. With the Lincoln Memorial in background, here's a sampling of the NPS electric fleet: (1) Electrobus by Otis Elevator, used as a shuttle between Washington, D.C. offices; (2) a three-speed staff car by Marathon, Ltd.; (3, foreground) three-wheel narrow-trail ranger patrol, assembled in Brentwood shops of National Capital Parks; (4) Taylor-Dunn tilt-up dump truck for servicing park walkway trash bins;

THE GREENING OF TECHNOLOGY

A case for parklands and waters nearer home

By John Hoke

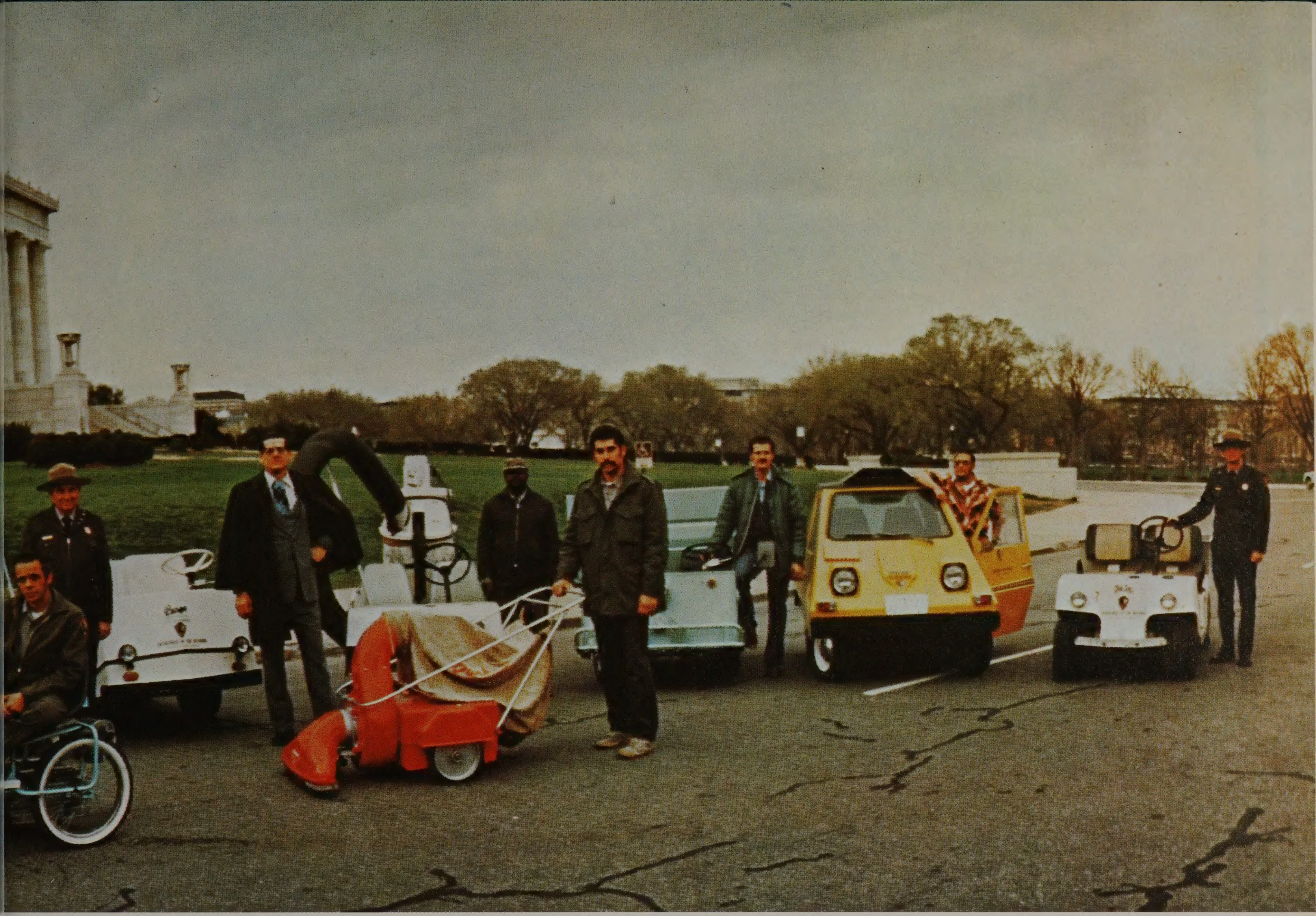
Holes in the ground—the fumaroles of Yellowstone—helped create the National Park System. When our prescient ancestors decided that Yellowstone's geysers were worth keeping intact, there were then few travelers likely to chance upon this enchanted place. But then there were some other holes in the ground a man named Col. E. L. Drake had drilled in Pennsylvania.

The product of our "holes" was a steam and hot water powered natural wonder. The product of the other holes was oil: the high-density fuel source that quickened the industrial revolution and made us a nation on wheels.

A by-product of the industrial revolution was its grab on our natural places. Wanderers were to become the more fervent in their search for the unspoiled places and our special sheltered exemplars of remaining natural excellence—the National Parks. These people in always increasing numbers were about to overwhelm these same parks that we with equal fervor try to protect. Visitor traffic also whetted the environmental conscience-searching that has been rising in us for many years.

Technology, the stuff of the industrial revolution, developed a notorious image in all this—particularly among the environmentally concerned. H. G. Wells (in his treatment, "Things to Come") provided an overly simplified reply: "Stop all progress." When today's environmentalists and technologists mix it up, Wells' suggestion is voiced frequently.

Holes are still being drilled in the ground and now in the seabeds. Oil from them is refined in every imaginable form, for petrochemicals and for energy. Technology now includes bigger, better, further, faster, more powerful,—and everywhere. This has made our people increasingly mobile. And now there are more of us. The wheels and other products of technology we bring into our parks often stifle our reasons for coming



(5, foreground) battery operated vacuum cleaner for collecting litter on the Mall; (6) silent ranger patrol car for lawns and park walkways; (7) materials handling Pargo flat bed for maintenance; (8) large electric vehicle for litter collection, assembled in NCP Brentwood shops; (9) Cushman tilt-bed dump truck for movement of heavy compost-soils; (10) CitiCar staff electric for ranger patrol on both streets and sidewalks; (11) Club Car hybrid-electric with gasoline-alternator package to provide unlimited-range patrol duty.

—to bask in the quiet and solitude our parks offer. And technology becomes the bad guy on which it is easy to blame these miseries.

But is technology and its power really the villain? Many think so. And those skilled in the use of technology often become the fall guys of this popular concept. Doing the jobs society asks to be done, technologists are building great human works, straightening rivers, leveling valleys, damming streams, crossing mountain passes, and draining swamps. They are then soundly drubbed as being the causes of many real or imagined environmental atrocities.

W. C. Fields once said "Anyone who hates children and dogs can't be all bad." The remark offers something better to do than just yell "stop" at technology's champions—don't worry so about "how bad" they seem. Look to what good they could do, if their efforts were aimed in another direction.

The people of technology are not all bad. There are about as many engineers as there are biologists numbered among environmentalists. Much good can come from such minds and their technology, properly applied to environmental needs. They are just as able, after making crooked rivers straight, to make straight rivers crooked again; to build a swamp rather than concrete it over—to redeem natural environment rather than destroy it. Many ways to use technology towards these ends present themselves—both the new, now in space, and the old. But getting technology turned around has been difficult, because getting next to scientific and technical people has been difficult for environmentalists confronted with technology's special world with its special language and disciplines.

They, no less than we, can be clannish: When going out for coffee an office of electrical engineers tends to set together around the snack table talking to themselves. They don't mix it up with mechanical engineers doing the same thing —talking to themselves—at the next table. This does little for cross-fertilization of ideas.

We must realize that numbers and fixed requirements are an important part of their world. We are more used to dealing with an environment less given to this kind of order. Our biologists are more at home dealing patiently with nature.

The technological mind relies heavily on something called *requirements*. These are the guide-rails that help keep technical minds on target in their work. They can also be misleading. On seeking advice about, say, a quiet engine that will burn anything (wood, alcohol, wastes, etc.) a space engineer might well frown upon it because he thinks it is too large. His *requirements* have called for trying to cram his things into a tiny space capsule that costs a grand, per pound, to

launch. He fails to realize that in a park, space and weight are not so binding. What we can derive from getting these minds in gear with us will spill out benefits like a cornucopia.

Technology's potential offerings cover about everything we do. Some applications will be routine, such as making our homes more comfortable with space-age insulation. Others will be far out, such as developing solar voltaic cells for electricity. New technology includes upgrading some of the old tools we have let slip by us, like windmills, and harnessing the many sources of power we have usually ignored, such as ocean tides.

Electric drive vehicles are a good example of yesterday's technical know-how that has value today. While they fell by the wayside in recent history, they could play a promising role toward solving today's petroleum scarcity problems. Their technical weaknesses—lack of range, and sustained high speed—were hard to justify compared to the gasoline engine when it come along. The internal combustion engine had one blinding charm: lots of power per pound, and it would go like blazes.

Electrics are obviously suited to urban driving conditions when lower speeds and range pose no problems, and so the Park Service introduced electric drives in park maintenance and people transport where they have proved to be both efficient and economical. And now we learn that the earlier "weaknesses" of electric drive may be solved by new fuel cells now in development.

Technology's rapid advance has often bypassed good ideas which surfaced too early. If some little thing chanced to be missing, the whole of the system or idea was easily discarded. Any good cookhouse operator knows how to deal with such situations when cooking up the rations. Back burners are where you push an incomplete stew to simmer—or await some missing potatoes. Ideas that come too early or whose full potential isn't realized, need to be allowed to simmer.

A good example is the external-combustion hot-air stirling engine that pioneered engine power, pumping water and doing other chores on the American farm and in early textile mills. Oil, with its high-density promises of speed and power, led us to simply dump these old devices, despite their simplicity and ease of maintenance, and ability to burn anything noiselessly. That these motorized devices lost out because they were "too slow" seems the unkindest cut of all.

We came to think that "fast is best." And so these old engines became the more useless because they can't drive today's fast-running gadgets fast enough—much as most of today's generators that are made that way because there no longer are any engines that run other than *fast!*

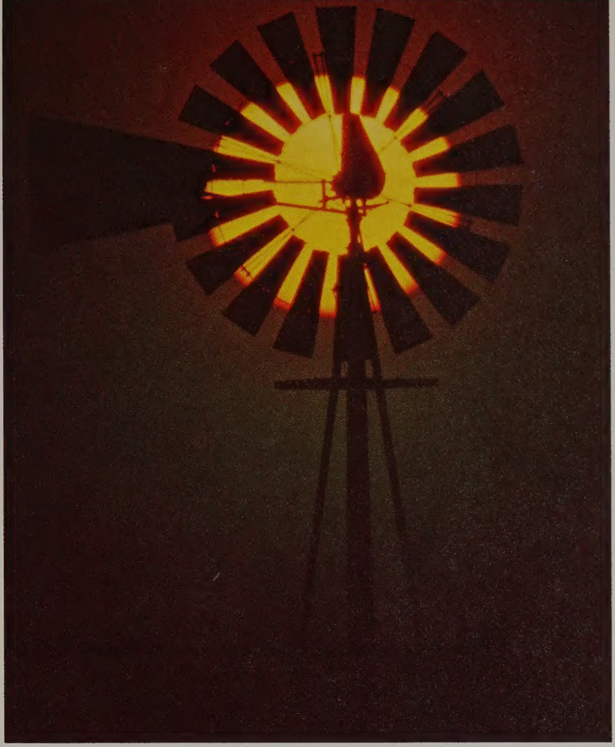
This is made the more bizarre with the recent arrival of some new and immensely more powerful magnetic materials that could vastly improve generator and motor technology, except that they work best at *slow* speeds! And so because today's technical buzz word is "fast," these promising materials could be threatened with the same fate as the earlier "slow" devices: they may be cast aside because they can't meet *today's* requirements. If stirling engine technology of the 1800's had been kept simmering on a back burner—to wait for these 20th century magnets and new materials like teflon and stainless steel—the technical result of this marriage of the "old" with the "new" might have kissed gasoline driven generators goodbye.

Other such "old-with-the-new" mixes include "prairie bonnet" windmills—now joined with space-age technology to do long and faithful service to capture the winds for energy. Such applications promise freedom from the environmental problems that go with many of today's machines dependent on pollution-prone depleting fuels. Today's miracle materials, applied to many of the simpler devices of yesterday, could well make them the engines of tomorrow.

Of course, there are possible pratfalls in prowling the technical world. But new technology—much of it spinoff from our space programs—and technology out of the past, re-examined, and perhaps upgraded with transfusions of modern materials, have much to contribute. Let's look at some of these possibilities.

New Lands from Waste Lands

Putting technology to work for us can have no better beginning than that we start undoing a lot of damage already



Oases of green, the author believes, may be created just about anywhere we choose—whether in a freeway maze or amid a big city's congestion. (Above). The time-honored windmill comes into its own once more with solar energy.

done—largely by misapplied technology—and remake abused environments. Yesterday's landfill can be the parkland of tomorrow.

"Dwindle" Into Green Growth

"Dwindling resources" is the bureaucratic phrase we use to describe such environmental losses. It implies that direction is one way: down. But who says we can't increase our natural resources? We can create oases of "natural" environment just about anywhere we choose, if, by "natural," we don't insist upon "untouched by human hands." The once over-cut Shenandoah National Park and the famed Blue Ridge Parkway offer striking examples of what nature, aided by man, can accomplish.

People now have become accustomed to driving in droves to visit remote parks at considerable distances and expense in funds and fuels. But as petroleum becomes dearer there will be less juice for the wheels that satisfy these yearnings.

We already have begun looking inward to rescue a few bits and pieces of natural area still in and near our cities. Cuyahoga (Cleveland and Youngstown) and the Gateway Parks of San Francisco and New York City are just such parcels of parks near people, rather that at the end of a long journey.

How to Build a Swamp

Many lands along rivers flowing through cities were ruined by the pollution fallout of the industrial revolution. (Who remembers when the Cuyahoga River, with its combustible wastes, caught fire in Cleveland?) We now have a handle on pollution, but what about the "dead" lands themselves? We now have the technical wherewithal to turn the process around—to resurrect these lands—and to create valuable wetland environments right in and next to our daily lives to yield the same recreational and other benefits that lead us to visit our remote parks.

This is where the heavy users of technology can continue to do their thing, only with a slight difference: "How to Build a Swamp," rather than obliterate one, becomes the objective. With the help of such specialists as fish and wildlife biologists, our bulldozers and dredges can create the habitats and niches in which wetlands life will thrive and grow. And take care of itself very well—once protected from the sources of pollution that had killed wetlands earlier.

Wetland "Oases"—Downtown

The same mix of skills and techniques can be put to work turning bare downtown pools, ponds, and fountains into living ecosystems for wetlands life. Bolivar Pond—a concrete memorial reflecting pool near the entrance of the Department of the Interior, in Washington, D.C., has been just such a place of wildlife for a number of years. In spite of its location in busy downtown Washington, the nearby hustle of city life and traffic doesn't discourage the annual spring migration of new life to the pond. Dragonflies, bees, and birds of all kinds find their way there; to join the turtle and fish life that live there all year round. This summer and last families of Mallard ducks raised ducklings there—much to enjoyment of the thousands of visitors to the pond to witness its reminder of the beautful legacy nature has to offer—particularly in the heart of a noisy city.

New Gardens of Babylon

Bringing natural green back into our urban lives doesn't mean sacrificing scarce land in cities, for it is in our cities where a form of space is peculiarly the more plentiful the *denser* the city. This space is the vast undiscovered country that is the rooftops of our cities. There are many older buildings well able to support mini-parks and "rooftop refuge" ecosystems for the benefit of city dwellers. New structures can be planned to support such parklands of the sky. This could place "parklands" within virtually walking distance of anywhere, even in the most concentrated areas of urban population.

Here is where the disciplines of technology and the natural sciences have so much to offer together—and where the hardware of the modern industrial world can help with the creation of ecosystems on rooftops. New plastic materials now exist for use on roofage that can last virtually forever, under the protecting blanket of living earth ecosystems. Aside

Mama Mallard finds a home on this tiny island placed in Bolivar pond at entrance to Main Interior Building in Washington, D.C.

from obvious social benefits, energy benefits are a valuable spinoff. Such living acreage would insulate the building roofage from thermal losses in all seasons. And the use of petroleum products that are now wasted on the constant repair of conventional roofage could cease.

"Recycle" Waste to Parklands

Composting nature's leavings is an ancient agricultural art. Modern technology can make it work in cities, too. The careful treatment of the effluent remains of sewage treatment plants—commonly called "sludge"—can provide a rich new earth for the creation of urban parklands on the most barren city block. Using techniques developed by the Department of Agriculture Experiment Station, at Beltsville, Md., Constitution Gardens, the former site of Navy buildings in Washington, was created by this new composting technology.

Specially prepared soils created from the tilling of raw sludge into a rich soil free of pathogens commonly found in raw sludge, provided the necessary growing medium to support the healthy growth of vegetation selected for Constitution Gardens.

The technique lends itself to many kiinds of land restoration. Fairgrounds—yearly laid bare by the trampling of but a few day's worth of visitors—can be restored economically. This relieves the yearly ritual of stripping local farmlands of valuable topsoil to resod such abused sites. A technique for composing left-over woodchips on the fairgrounds—right in place—was tried on the site of the annual Festival of American Folklife in Washington, D. C. Following this three-month long heavy-traffic event, the 50-acre site was a mess and six-inches deep in woodchip compacted to a density near that of concrete. Properly sodding the site would have cost nearly a million dollars—and would have called for the ruining of equal rural grasslands acreage. All that woodchip would have had to first be picked up and removed. And to where?

The product of this experiment in *"in-situ"* composting was healthy renewed parkland, at but a fraction of the usual costs, as well as tremendous savings in the cost of oil and chemical-based fertilizers usually expended in the conventional cleaning up and restoration of such lands.

A lot of unusual technical hardware can get into the act, putting these new composting approaches to work. As experiments with composting sludge advance to where certain health considerations are dealt with, greater applications of this technology will extend into the farming world, and urban landworking everywhere. Giant concrete-mixer trucks (if you will regard them, here, as resembling mobile "food" blenders) could deliver special mixes of compost materials and soil enriching ingredients to landscapers—the ingredients being "blended" enroute by the mixer truck.

Creating "new" natural environment resources from urban resources could bring natural environment where people live—and reverse the pattern of traveling great distances to commune with nature.

Technology's New Bag

A host of new materials, first tried in space, can help us in our parks. These include such adhesives as the silicones used to seal space capsule windows. They are extremely durable when fixing things in a weathering environment. New synthetic lubricants are more effective than many older forms that contain the slippery metal, molybdenum. A vast bag of new plastics offer infinitely better choices for everything from trash bins and covers, to housing for machinery. Some of the new plastics make finer bearings than any others—particularly where weather deteriorates metal bearings. Among these is teflon, which can stand unusual heat. (It's what keeps eggs from sticking to frying pans.) Except for extremely heavy weight, teflon has no peer as a bearing needing no oil whatsoever.

New technology has birthed such products as electroluminescent illumination (EL). Akin to the fluorescent light (a distant cousin), this flat and flexibile low-level light source available in strips, circles—most any shape—draws virtually no current.

In long thin strips it would serve ideally as walkway railing lighting, in places where afterdark activities are part of visitor experiences in a park—like the boardwalk trails in the Everglades. Night-

(Above and right). Turtles and a wild mallard co-exist with roaring traffic in a green space in Washington, D.C.

(Left) Cyclists along the Chesapeake & Ohio Canal stop to admire the new electric patrol vehicle piloted by National Park Technician Ann Brooks.

life noises of the alligators, and other nocturnal life, are the natural "music" of the park. But if you light your way there with a flashlight, the reason you came will cease as the nightlife shuts up in the presence of the flashlight.

EL would lend itself to back-light illumination of the formations in our cave parks. Its soft cool glow would lend an eerie quality to the cave experience—and EL lighting will not support the unnatural algae growth that have intruded these caves, with our installation of incandescent electric lights.

Worn on park naturalists' hats—EL would let them wander about in the dark while surveying wildlife, without disturbing animals. Special spectrums of this form of lighting (also used on the wingtips and instrument panels of military aircraft) are virtually invisible to the wildlife being studied. Trailside information maps could be illuminated by EL—recharged, daily, by solar panels.

Parks in our Homes

"Don't pick the flowers" signs are one of our warnings to our visitor that it's a no-no to take away these resources as souvenirs. This does little to satiate these justifiable yearnings the park experience generates in the visitor—to bring something of it back into his home life. Technology offers a way to do this, without harming the resource.

The seeds of unique vegetation found in some parks could be husbanded for sale by park concessionaires. New plastics for making miniature environment terrariums make possible the growth of just about any form of plantlife—under special plant-growing lamps, in a city apartment. Park visitors would be less tempted to furtively pluck park flowers when they could grow the seeds of such plants to enjoy them thriving at home months later.

Sounds of our Parks

To some a transistor radio blaring in a remote park wilderness can prove an offensive intrusion by this technology. But this same electronic science offers something new to take home—the sounds of our parks. Whether it be the bellowing of 'gators in the Everglades, the hiss of geyser eruptions in Yellowstone, or surf and wind sounds of Hatteras, the "music" of our parks is part of their character.

Recording these fleeting, often seasonly-silent, sonic events is not expensive or difficult and would offer yet another living part of our parks that people could take *home with them,* for the vivid sensual refreshment when replayed in the bleak of winter.

Test Beds for Technology

While busying ourselves rummaging through modern technology's bag, the people who are responsible for this progress will increasingly come to know which of the things they are developing might be useful to us. Every so often technologists come up with some spinoff of their work that they know is good stuff, but they can't think of a good use for it. (Even the pharmacologist sometimes comes up with a fine medicine for which he has no disease!) This kind of progress can be best proven useful if there is a place to try out new ideas. The resources of the National Park Service are singularly useful for this purpose. We are a very micrososm of the American scene: You name it, we have places that are high and low, hot and cold, wet and dry, in caves, under the sea, and on the highest mountains—and everywhere in the American nation. They would be fine sites for the testing evaluation of every conceivable technical concept and its products. We should enthusiastically join with other agencies—both government and private—and use this vast test bed for the exploration of new ideas. We have the technical and administrative strengths to evaluate and control such a program so that great benefits may be realized. Environmentalists have much to gain by moving closer to technology's knowledge bank.

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